TOXICITY OF

PULP AND PAPER EFFLUENTS

IN ONTARIO

(January, 1969 to December 1985)

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GLOSSARY

Toxicity

Many people equate "toxicity" with acute lethality to fish, since that is a common use, but toxicologists think of toxicity in much broader terms including bioaccumulation, growth effects, reproduction effects, etc. The broader viewpoint is appropriate to any wastes in surface waters. "Toxicity" therefore is any undesired effect on organisms or ecosystems.

Acute vs. Chronic

An acute effect comes speedily to a crisis or end-point while a chronic effect is long lasting or continued. The words "acute" and "chronic" in connection with toxicity tests refer to short (acute) and long (chronic) exposures. They require a specific organism as a reference. For a Daphnia (water flea) with a life cycle of weeks, acute usually means two days or less while chronic usually means a week or more. However, for trout with a life cycle of years, acute usually means four days or less and chronic means several months or more.

Lethal vs. Sublethal

The term lethal refers to an effect or a test where deaths result, while sublethal refers to those where there is an effect but no deaths. Both can involve acute or chronic exposures.

96 Hr. LC50

LC50 is a symbol for "median lethal concentration". The 96 hour LC50 is the concentration, expressed as percentage effluent, mg/l or other unit of concentration, that kills 50% of the animals during 96 hours of exposure.

SUMMARY

The following report presents historical toxicity data from static rainbow trout toxicity tests performed on pulp and paper mill effluents at the Ontario Ministry of the Environment's Aquatic Toxicity laboratory in Rexdale as well as through contract with the Toxicity laboratory at the Lakehead University in Thunder Bay. The data, presented here, cover the period from January, 1969 to December, 1985 and this report includes brief descriptions of the mills and indicates their locations on site maps.

The 96-hour LC50 acute lethality bioassay represents a statistical evaluation of the concentration of a sample required to kill 50% of the test fish in 96-hours. It is a direct assessment of the toxicity of an effluent, water sample or chemical substance. For complex samples such as effluents, results of the LC50 test are generally expressed as a percentage reflecting the ratio of effluent to laboratory dilution water. An LC50 value of 100% indicates that half of the fish survive in full strength effluent. As a rule of thumb, when evaluating LC50 results, the degree of toxicity is inversely related to the ratio of effluent to laboratory dilution water. That is the lower the LC50 value is in percentage, the more toxic is the effluent.

In terms of their acute lethality to fish, the most toxic pulp mill effluent samples come from the sulphite mills followed by the kraft pulping mills and then by the thermo-mechanical mills. The paper mill effluents are generally the least acutely toxic. There are differences that are attributable to site-specific characteristics; however, it is possible to roughly rank the mills in order of toxicity to fish. Appendix 'A' illustrates the acute lethality estimates obtained with recent samples from the mills throughout Ontario. While the order of occurrence of samples is maintained in these bar charts, the time scale has been compressed. The order of placement of the mills is roughly in order of increasing toxicity. Table 1 compares Ontario mills in terms of characteristics that would be most relevant to toxicity. Table 2 lists the Ontario pulp and paper mills alphabetically and Figure 1 illustrates their approximate location.

It is clear, that sulphite mills, as a group, are the most toxic. Wastes from sulphite mills are generally considered to be the most difficult to treat to remove toxicity. If sulphite mills are to continue to operate, a concerted effort in toxicity removal research must take place.

Paper mills (i.e. mills that do not produce their own pulp) have effluents that exhibit the least acute lethality to fish and are frequently non-lethal. It is reasonable to expect that, with careful management, they could meet a toxicity requirement. The remaining mills are either Kraft mills or contain mixtures of various types. Three of these mills in Ontario now have some secondary treatment (E.B. Eddy in Espanola, Boise Cascade in Fort Frances, and Great Lakes Forest Products Limited in Dryden). Effluent from the mill in Espanola is normally non-lethal to fish except perhaps during occasional spills. With continued diligence, it should meet an effluent toxicity requirement. There have been periods in the last few years when the effluent from Great Lakes Forest Products Limited in Dryden has been non-lethal, indicating that secondary treatment can be effective at toxicity removal. Boise Cascade in Fort Frances, on the other hand, clearly has a toxic discharge despite secondary treatment.

A 1986 report on pulp and paper mill toxicity, prepared by McLeay and Associates, claims that properly operated secondary treatment significantly reduces the toxicity of Kraft mill effluents (5). Further investigation of the functioning of secondary treatment facilities for toxicity removal is necessary.

RÉSUMÉ

Le rapport qui suit présente une série chronologique de données d'essais statiques portant sur la toxicité des effluents d'usines de pâtes et papiers pour la truite arc-en-ciel. Une partie des essais a été réalisée par le Laboratoire - Toxicité pour les organismes aquatiques du ministère de l'Environnement de l'Ontario, à Rexdale, l'autre partie ayant été confiée au laboratoire d'analyses toxicologiques de l'Université Lakehead, à Thunder Bay. Les données se rapportent à la période de janvier 1969 à décembre 1985; le rapport comprend en outre de courtes descriptions des usines et précise leur emplacement sur des cartes.

La toxicité aiguë s'exprime par la D.L. 50/96 h qui est l'évaluation statistique de la dose létale ou concentration de la substance qui tue à coup sûr en 96 h 50 pour 100 des poissons soumis à l'essai. Il s'agit d'une évaluation directe de la toxicité d'un effluent, d'un échantillon d'eau ou d'un produit chimique. Pour les échantillons complexes comme les effluents, les résultats sont généralement exprimés par un pourcentage représentant la proportion d'effluents par rapport à l'eau de dilution du laboratoire. Ainsi, une D.L. 50 de 100 pour 100 signifierait que la moitié des poissons survit dans l'effluent non dilué. Le degré de toxicité étant inversement proportionnel au rapport de la quantité d'effluents sur la quantité d'eau de dilution, plus le pourcentage exprimant la D.L. 50 est faible, plus l'effluent est toxique.

D'après les analyses, les échantillons les plus toxiques pour le poisson proviennent des usines de pâte au bisulfite, après quoi suivent, par ordre d'importance décroissante, les usines de pâte kraft et les usines de pâte thermomécanique. Les effluents des papeteries sont généralement les moins toxiques. Certaines différences sont attribuables aux caractéristiques particulières de l'emplacement, mais il est possible de faire un classement

approximatif des usines d'après la toxicité de leurs effluents pour le poisson. L'annexe A présente, sous forme de graphiques en colonnes, l'évaluation de la létalité d'échantillons récents provenant d'usines de toute la province. La chronologie des échantillons est représentée dans les graphiques, mais l'échelle de temps est comprimée; les usines figurent approximativement par ordre croissant de toxicité. Le tableau 1 compare les usines de l'Ontario en fonction des caractéristiques dont dépend le plus la toxicité. La tableau 2 donne la liste alphabétique des usines de pâtes et papiers de l'Ontario, et la figure 1 illustre leur emplacement de façon approximative.

Il ressort clairement que les effluents des usines de pâte au bisulfite, prises collectivement, sont les plus toxiques. On considère généralement qu'ils sont les plus difficiles à assainir. Ainsi, si l'on veut continuer à exploiter ces usines, il faudra un effort concerté de recherche dans le domaine de l'assainissement.

Les effluents des papeteries (c'est-à-dire des usines qui ne produisent pas elles-mêmes la pâte à papier utilisée) sont les moins toxiques pour le poisson; bien souvent, ils ne sont pas mortels. On peut croire que, dûment traités, ils pourraient répondre aux exigences. Il reste donc les fabriques de pâte kraft et les usines mixtes. Trois de ces usines, en Ontario, disposent déjà de dispositifs de traitement secondaire (E.B. Eddy, à Espanola, Boise Cascade, à Fort Frances, et Great Lakes Forest Products Limited, à Dryden). Les effluents de l'usine d'Espanola ne sont normalement pas mortels pour le poisson, sauf peut-être en cas de déversements accidentels. Si l'on s'en occupe sérieusement, ils pourront répondre aux exigences relatives à la toxicité. Il est déjà arrivé, au cours des dernières années, que les effluents de la société Great Lakes Forest Products Limited ne soient pas létaux, ce qui laisse croire que le traitement secondaire peut servir à l'assainissement de façon efficace. Il est cependant certain que

les déversements de Boise Cascade, à Fort Frances, demeurent toxiques malgré un traitement secondaire.

D'après un rapport présenté en 1986 par McLeay and Associates au sujet de la toxicité des usines de pâtes et papiers, le recours à un traitement secondaire adéquat réduit sensiblement la toxicité des effluents des usines de pâte kraft (5). Il faudrait cependant étudier davantage le fonctionnement des installations de traitement secondaire.

Table 1. Characteristics of Ontario Pulp Mills.

MILL	LOCATION	WOOD TYPE		DEBARKING			PROCESSES						CHEMICAL RECOVERY	BLEACHING TYPE	PRODUCTS metric tons/day							TREATMENT		FLOW
		soft wood	hard wood	Wet	Dry	None	Secondary Fibre	Sulphite	Kraft	Ground Wood	TMP	Deinking			Market Pulp	Unbleached Pulp	News Print	Fine Paper	Box Board	Tissue	Other Products	Primary	Secondary	cubic M/day
Abitibi Price	Ft.William	X	.	X	.	.	.	.	.	X	SCMP	.	NO	Boro-hydro sulphide	.	.	347	.	.	.	.	X		22800
Abitibi Price	Iroquois Falls	X	.	X	.	.	.	X	.	X	.	.	NO	brightener	.	.	810	.	.	.	.	X	.	50000
Abitibi Price	Smooth Rock Falls	X	.	X	.	.	.	.	X	.	.	.	YES	CEHDED	325	.	.	.	.	.	lumber	X	.	65000
Abitibi Price	Thunder Bay	X	.	X	.	.	.	X	.	X	.	.	NO	Boro-hydro sulphide	.	.	432	.	.	.	.	X	.	34800
Abitibi Provincial	Thunder Bay	X	X	.	X	.	X	.	.	X	.	.	NO	hydrogen peroxide	.	.	.	340	.	.	.	X	.	53300
Beaver Wood Fiber	Thorold	.	.	.	.	X	X	.	.	.	.	.	NO	.	.	.	.	.	X	.	.	X	.	14700
Boise Cascade	Fort Frances	.	.	.	.	.	.	X	X	X	.	.	YES	.	.	.	X	.	.	.	.	X	X	71000
Boise Cascade	Kenora	X	.	.	.	.	.	X	.	X	.	.	NO	.	.	.	420	.	.	.	.	X	.	52000
Domtar	St. Catharines	.	.	.	.	X	X	.	.	.	.	.	NO	.	.	.	.	X	.	.	.	X	.	9850
Domtar	Thorold	.	.	.	.	X	X	.	.	.	.	.	NO	.	.	.	.	.	.	.	felt	.	.	774
Domtar	Cornwall	.	X	.	X	.	.	.	X	.	.	.	YES	CE(D)DED	350	.	.	750	.	.	.	X	.	122000
Domtar	Red Rock	X	X	X	.	.	.	.	X	X	.	.	YES	.	740	.	X	.	X	.	.	.	.	98800
Domtar	Trenton	.	X	.	.	.	.	.	.	.	Na2CO3	.	NO	NONE	.	.	.	.	X	.	.	X	.	1840
E.B.Eddy	Espanola	.	.	.	.	.	.	.	X	.	.	.	YES	.	.	.	.	.	.	.	.	X	X	94300
E.B.Eddy	Ottawa	.	.	.	.	X	X	.	.	.	.	.	NO	NONE	.	.	.	X	.	.	.	X	.	8000
Fraser Inc	Thorold	.	.	.	.	X	X	.	.	.	.	X	NO	C,H	.	.	.	X	.	.	.	X	X	25300
Great Lakes Forest	Dryden	X	X	.	.	.	.	.	X	.	.	.	YES	.	.	.	.	900	.	.	.	X	X	79500
Great Lakes Forest	Thunder Bay	X	X		X	.	.	X	X	X	.	.	YES	.	1000	.	1000	.	.	.	lumber. chemicals	X	.	269000
Jaees River	Marathon	X	X	.	X	.	.	.	X	.	.	.	YES	CdEoHED	450	.	.	.	.	.	.	.	.	66000
Kimberly-Clark	Hunstville	.	.	.	.	X	.	.	.	.	.	.	NO	.	.	.	.	.	.	X	.	X	X	480
Kimberly-Clark	St. Catharines	.	.	.	.	X	X	.	.	.	.	.	NO	.	.	.	.	.	.	X	.	X	X	8260
Kimberly-Clark	Terrace Bay	X	X	.	X	.	.	.	X	.	.	.	YES	.	1200	.	.	.	.	.	lumber	.	.	136000
MacMillan Bloedal	Sturgeon Falls	.	.	.	.	.	.	X	.	.	.	.	NO	.	.	.	.	.	X	.	.	X	X	12100
Ontario Paper	Thorold	X	X	.	.	X	X	X	.	.	TMP,CMP	X	YES	boron	.	.	X	.	.	.	.	X	X	119000
Spruce Falls	Kapuskasing	X	.	X	.	.	.	X	.	X	X	.	MAGNEFITE	brightener	.	.	950	.	.	.	lumber	X	.	90000
Strathcona Paper	Strathcona	.	.	.	.	.	X	.	.	.	.	.	NO	NONE	.	.	.	.	X	.	.	.	X	3620
St. Marys Paper	Sault Ste. Marie	.	.	.	.	.	.	.	.	X	.	.	NO	.	.	.	.	.	.	.	.	.	.	28600
Trent Valley	Glen Miller	.	.	.	.	.	X	.	.	.	.	.	NO	NONE	.	.	.	.	X	.	.	X	.	3200

Table 2: List of Ontario Pulp Mills (see Figure 1 for locations).

No.	Name	Location
1.	Abitibi Price (Fort William)	Thunder Bay
2.	Abitibi Price	Iroquois Falls
3.	Abitibi Price	Smooth Rock Falls
4.	Abitibi Price	Thunder Bay
5.	Abitibi Price (Fine Paper)	Thunder Bay
6.	Beaver Wood Fibre Co. Ltd.,	Thorold
7.	Boise-Cascade	Fort Frances
8.	Boise-Cascade	Kenora
9.	Domtar Construction	Thorold
10.	Domtar Fine Papers	St. Catharines
11.	Domtar Fine Papers Co. Ltd.,	Cornwall
12.	Domtar Packaging Co. Ltd.,	Red Rock
13.	Domtar Packaging Co. Ltd.,	Trenton
14.	E.B. Eddy Forest Products	Espanola
15.	E.B. Eddy Forest Products	Ottawa
16.	Fraser Inc.,	Thorold
17.	Great Lakes Forest Products	Dryden
18.	Great Lakes Forest Products	Thunder Bay
19.	James River	Marathon
20.	Kimberly-Clark of Canada	Huntsville
21.	Kimberly-Clark of Canada	St. Catharines
22.	Kimberly-Clark of Canada	Terrace Bay
23.	MacMillan Bloedel	Sturgeon Falls
24.	Ontario Paper Co. Ltd.,	Thorold
25.	Spruce Falls Power & Paper Co.,	Kapuskasing
26.	Strathcona Paper Co. Ltd.,	Strathcona
27.	St. Mary's Paper	Sault Ste Marie
28.	Trent Valley Paperboards	Glen Miller

Figure 1. Ontario Pulp and Paper Mills.

INTRODUCTION

"Chemical examination alone of a complex industrial waste does not provide sufficient information on its effects on the aquatic biota or for the protection of the aquatic environment. Moreover, the toxicity of a complex mixture of wastes and chemicals cannot be determined by chemical means." (1).

Toxicity Testing

The results of toxicity testing contained in this report are based on a procedure common to water quality assessment in Canada. Rainbow trout are exposed to a test sample under static conditions and mortalities over a period of four days are recorded. From these records of mortality, an LC50 is statistically calculated. An organism exposed under controlled conditions to these mixtures will provide a summated biological response. The static 96-hour trout bioassay evaluates such a response.

This basic bioassay can answer a number of questions about a sample (water, effluent or specific chemical) being tested:

- -Is it toxic?
- -How toxic is it?
- -Does its toxicity vary with time?
- -Is fish mortality likely to occur in the receiving water?
- -How effective are treatment methods in reducing toxicity?

In the basic, short-term acute lethality test, an equal number of test animals are put into each container and exposed to the sample and dilutions of the sample for 96 hours. The number of dead animals in each container is counted and removed at regular, pre-determined periods. Following the exposure period, the LC50 value is calculated. Appendix 'B' describes details of the rainbow trout static 96-hr acute lethality test.

In addition to following the testing protocol, it is important that special attention be given to sampling, shipping and storing of samples for toxicity tests. While the total time from sampling to performing the test must not exceed five days, no more than two of these days should be spent in shipping or at warm temperatures. For each sample, 80 litres should be sent in plastic pails lined with plastic bags. No head space should be permitted.

The unit of measurement of the short-term toxicity test is the estimated median lethal concentration (LC50). This value is the concentration which is lethal to 50% of the test animals at the end of a predetermined exposure interval. Thus, a 96-hour LC50 is the concentration of a toxicant that will kill half the test oganisms in 96-hours.

It is important that the LC50 not be confused with a "safe concentration" of a toxicant. Usually the "safe concentration" of a substance or effluent is obtained by multiplying the LC50 value by an appropriate application factor and/or reviewing sublethal and chronic data for fish and other aquatic organisms.

Those components of effluents which are more persistent or can bioaccumulate to high concentrations in biota will require much greater controls. Substances in this category include many of the metals (e.g. mercury) and some higher molecular weight chlorinated organics (e.g. pentachlorophenols).

Given the complex mixture of substances in effluents, a lack of toxicological data and environmental criteria for many industrial substances as well as an inadequate understanding of additive, synergistic or antagonistic effects, more and more industrial and regulatory agencies are turning to the use of whole effluent toxicity tests for monitoring and controlling discharges to the aquatic environment. The integrative nature of the test measures the lethality of all the toxicants present acting simultaneously.

Provincial Standards for Pulp and Paper Mill Effluent Control

Under the Canada-Ontario accord, Ontario has agreed to establish and enforce effluent requirements at least as stringent as the federal baseline requirements.

The Ontario Ministry of the Environment utilizes the fish toxicity test to identify industrial discharges acutely lethal to aquatic organisms as referred to in Policy 3 of the Ministry's Water Management Goals, Policies, Objectives and Implementation Procedures (2). This toxicity test may also be used to determine violations of the following Provincial legislation (3), (4):

a) The Ontario Water Resources Act; Revised Statutes of Ontario, 1980, Chapter 361, Section 16

(1), Every municipality or person that discharges or deposits or causes or permits the discharge or deposit of any material of any kind into or in any well, lake, river, pond, spring, stream, reservoir or other water or watercourse or on any shore or bank thereof or into or in any place that may impair the quality of the water of any well, lake, river, pond, spring, stream, reservoir or other water or watercourse is guilty of an offence. R.S.O. 1980, c. 361, s. 16(1); 1986, c. 68, s. 12(1).

b) The Environmental Protection Act; Revised Statutes of Ontario, 1986, Chapter 141. Section 13

(1), Notwithstanding any other provision of this Act or the regulations, no person shall deposit, add, emit or discharge a contaminant or cause or permit the deposit, addition, emission or discharge of a contaminant into the natural environment that,

a) causes or is likely to cause impairment of the quality of the natural environment for any use that can be made of it;

b) causes or is likely to cause injury or damage to property or to plant or animal life;

c) causes or is likely to cause harm or material discomfort to any person;

d) adversely affects or is likely to adversely affect the health of any person;

e) impairs or is likely to impair the safety of any person;

f) renders or is likely to render any property or plant or animal life unfit for use by man;

g) causes or is likely to cause loss of enjoyment of normal use of property; or

h) interferes or is likely to interfere with the normal conduct of business. R.S.O. 1980, c. 141, s. 13(1); 1983, c. 52, s. 4.

TOXICITY TESTING AND MISA

(Municipal/Industrial Strategy for Abatement)

MISA

The Municipal/Industrial Strategy for Abatement or MISA is intended to provide a uniform and systematic way of integrating water management activities leading to a comprehensive abatement strategy to control hazardous as well as conventional discharges from municipal and industrial sources.

As can be seen from review of this document, many of the effluent samples received from the pulp and paper industry in Ontario are lethal to fish. A summary bar chart (Appendix 'A') is provided with this report placing mills approximately in order of toxicity. While the sample results are in the order in which they were completed, the time scale has been removed. Data incorporated into this figure are from samples collected up to 1985 except in a few locations where data up to only 1984 were available. The individual results are contained in the body of the report.

The Basic Principle

If all discharges are controlled to the point that they do not kill fish at any point in the environment, including the point of discharge, meaningful improvements in Ontario's water quality will occur. The same philosophy was used in the development of sectoral regulations under the Federal Fisheries Act in the early 1970's. These regulations have only been partly effective for the pulp and paper sector, since the toxicity requirements have yet to be applied to existing facilities.

Compliance

It is essential to establish clearly what constitutes compliance with respect to toxicity. The most logical endpoint is that any sample taken from an effluent should not be lethal to more than 50% of the test fish at 100% effluent concentration in the test period of 96 hours (96 hr. LC50 >100%).

Keeping in mind practical limits of testing, this can be determined by monthly toxicity tests on all undiluted final effluents. Should an effluent prove non-lethal by this procedure over three consecutive months, sampling frequency could be reduced to quarterly. Subsequently, if any quarterly sample should prove lethal to fish, monthly bioassays could resume. The dates of sampling should be fixed in advance.

Industry has been encouraged to practice water conservation and this has lead to several benefits including reduced waste loading to a waterbody. Acute lethality, however, is a concentration-based effect and is not related to loading. It is useful for the environment to have limits on both effluent loadings for far-field environmental protection and effluent concentrations for protecting the environment close to the source.

Legal Authority

Existing water pollution legislation obligates the Ministry to ensure that discharges are being assessed and controlled with respect to toxicity. A discharge that kills fish is considered to be a "contaminant" under Section 13 of the Environmental Protection Act (4). Several successful prosecutions using toxicity evidence support this interpretation.

Chemical vis-a-vis Biological Monitoring and Control

The best use of biological testing is to determine <u>whether</u> toxicity exists. If an effluent is toxic, the best use of chemistry is to subsequently determine <u>what</u> is the cause of that toxicity. While fundamental to monitoring and control of discharges, chemical analyses represent only an indirect means of determining potential effects in the receiving water. The knowledge of effects caused by various

concentrations, mixtures, in various kinds of receiving water is a most important yet elusive link between knowledge of effluent concentrations and environmental effects. Toxicity tests, on the other hand, represent a direct measurement of significant environmental effect. To be sure, there are problems of effluent concentration variability and confounding environmental factors such as pH, hardness and temperature, yet, these are minor factors compared to the uncertainty of judging environmental impacts based on chemical parameters alone.

Quality Control and Management of Toxicity Test Data

MOE is frequently asked whether there will be accreditation of toxicity testing laboratories. Current opinion within the Water Resources Branch is that accreditation would not be a particularly effective way of ensuring quality or accuracy of data from toxicity testing facilities. There is no guarantee that laboratories possessing a certificate of accreditation would consistently maintain high standards. Staff changes for example, could affect the quality of test results. Better accuracy can be assured by the use of an ongoing series of split samples (audits) to keep a continuous track of data quality.

While toxicity and chemical-based results can be used effectively together for environmental management, data from toxicity tests have a completely different structure than chemical/physical parameters. It is, therefore, necessary to manage toxicity testing data independently. The most practical approach to managing data flow is to have data submitted in electronic form from the dischargers laboratory to the Ministry where it will subsequently be distributed with an interpretation and quality control data through monthly reports. The Aquatic Toxicity Unit is preparing a microprocessor program for managing toxicity data and this program can be made available for such a data network.

Rapid Lethality and Rainbow Trout Bioassays

The phrase "rapid lethality" used in the Ontario Ministry of the Environment's Water Management publication (2) to describe a condition not permitted in a mixing zone, while clear enough in intent, requires a philosophical reference point for practical application. Fortunately,

the 96 hour acute lethality test to rainbow trout, which has an enormous library of data from which to judge discharges of complex effluents, represents just such a reference point.

Does the LC50 toxicity test reflect a measure of lethal conditions in general and not just for trout? Does it reveal "rapid" responses if it lasts four days? The rainbow trout is not the most sensitive organism in aquatic environments. It is chosen as a test species, partly, because it is robust enough to be cultured conveniently in the laboratory while most aquatic species cannot. If rainbow trout barely survive conditions of a discharge in four days, there are surely many organisms just as important to the aquatic community that would survive for only very short periods. The fixed period of four days is primarily chosen to express results in a reproducible fashion. Yet, because the response to most toxicants is logarithmic with respect to duration of exposure, the majority of mortalities most commonly occur near the beginning of the test. Clearly, the rainbow trout test measures "rapid lethality".

Mixing Zones

It is not realistic to expect that all areas within a waterbody will be completely free of all toxic effects or that they will meet all Provincial Water Quality Objectives (P.W.Q.O). Mixing zones are, therefore, established to provide an acceptable transition zone between the end of the pipe and the natural environment. Strict requirements minimize adverse effects within the mixing zone. It is outside the framework of this report to discuss mixing zones in detail, however, a reasonable goal is for all discharges in the province to be non-lethal to fish at the point of discharge thus minimizing the chance of widespread toxic effects in the receiving waterbody.

Other Toxicity Tests

There are a variety of other testing techniques that have been in use for a number of years to assess sublethal and chronic effects. Such tests employ a variety of organisms. Just as acute lethality to trout

is an essential component of technology-based controls, so are these other tests essential components of water quality-based monitoring and controls.

There are possibly only a very few, small areas of the Ontario waters that are acutely lethal to fish. The most significant impacts are the more subtle, sublethal or chronic effects. If the toxicity of an effluent is reduced to non-lethal at the point of discharge, then the extent of sublethal impacts will also be reduced. The Ministry must be prepared, on a site-specific basis, to assess the extent of these effects so that decisions can be made about the adequacy of existing or proposed controls. For this purpose, the Ministry employs a battery of techniques both in the lab and field to directly measure impacts on aquatic biota. Various candidate procedures are presently being evaluated by the Water Resources Branch and formal protocols are being written. Among these are early life stage toxicity tests (eg. seven day fathead minnow larval growth test); behavioural and respiratory stress test in fish; field caging procedures for fish and aquatic invertebrates; invertebrate acute lethality tests (eg. to Daphnia magna); algal growth tests; and tests involving genotoxicity.

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5. Aquatic Toxicity of Pulp and Paper Mill Effluent: A Review, 1986. D. McLeay Associates Ltd. Vancouver, B.C.

RAINBOW TROUT ACUTE LETHALITY DATA

This record of waterborne pulp and paper waste quality across the province has been compiled to provide a background for current effluent toxicity conditions. The data have been compiled from bioassay tests requested by regional staff from January, 1969 to December, 1985. Bioassays were conducted at the Ministry of the Environment Toxicity Laboratory in Rexdale and at Lakehead University under contract with the Ministry.

The toxicity data for the twenty-eight mills have been organized alphabetically under the company's name. Included with these data are maps indicating mill locations, mill background histories and nominal chemistry.

Abitibi Price Inc., Fort William Division, Thunder Bay

Abitibi Price, Inc., Fort William Division (Mission River Mill), Ft. Wm.Mill, Thunder Bay.

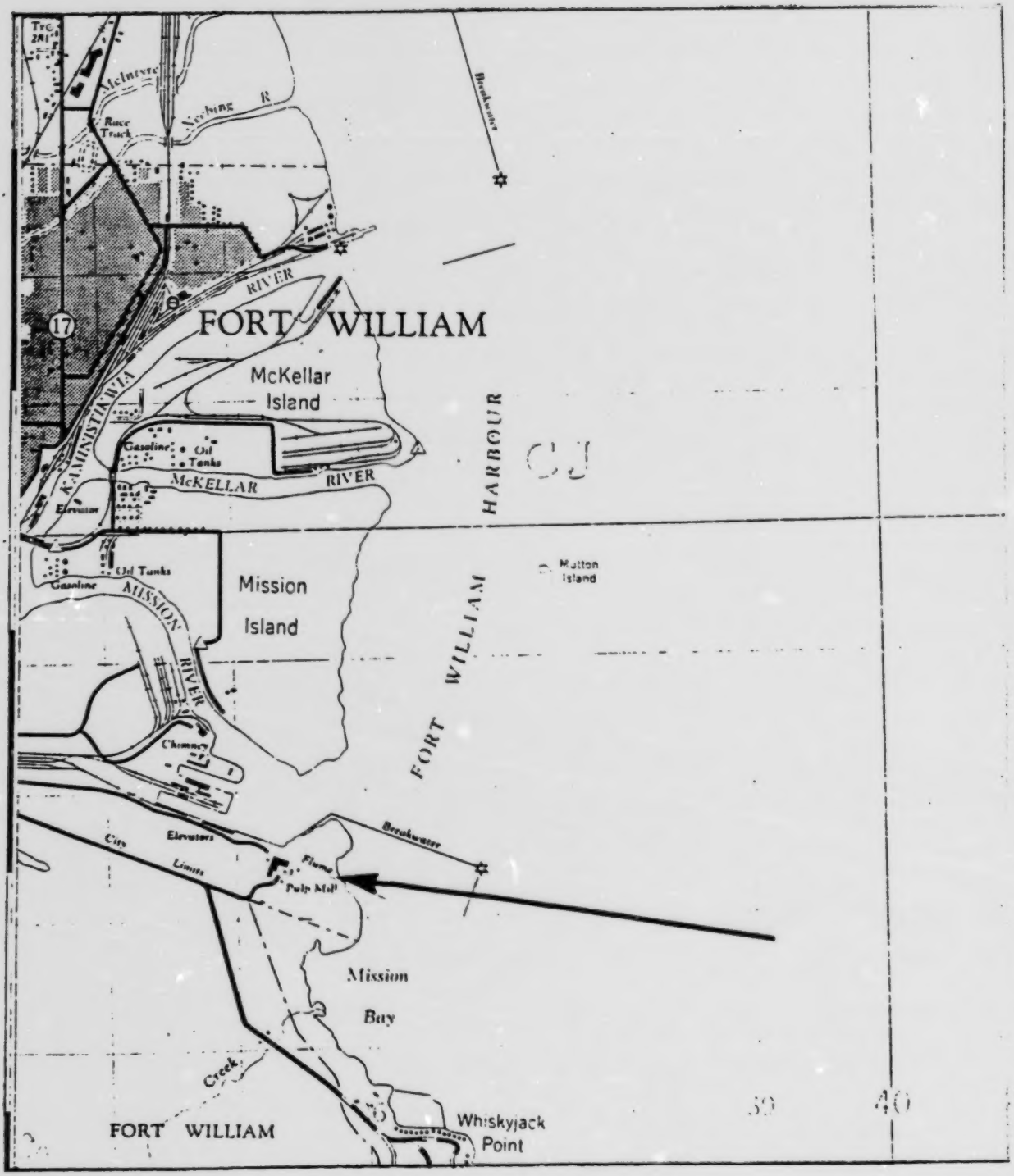
Receiving watercourse: Thunder Bay to Lake Superior

flow:	23300	cu m/day	BOD:	7680	Kg/day
PHOS:	10.8	Kg/day	SS:	1210	Kg/day

The final effluent is toxic to fish. Three trout bioassays, conducted in 1985, indicated that it would take statistically, 47.9%, 42.8% and 42.8% effluent to kill 50% of the test fish by the end of four days exposure.

The mill was originally constructed as a groundwood mill. Prior to December 1981, the company operated both a groundwood and sulphite pulping operation.

In December 1981, the company abandoned the sulphite process and started the SCMP process. Softwood logs and chips are made into newsprint. The mill consists of wet drum debarking, sulphonated chemi-mechanical pulping (90% yield), groundwood pulping, groundwood brightening, adding purchased kraft and papermaking. The mill utilizes a clarifier and lagoons for wastewater treatment.


FORT WILLIAM
McKellar Island
McKELLAR RIVER
KAMINISTIKWIA RIVER
HARBOUR
Mutton Island
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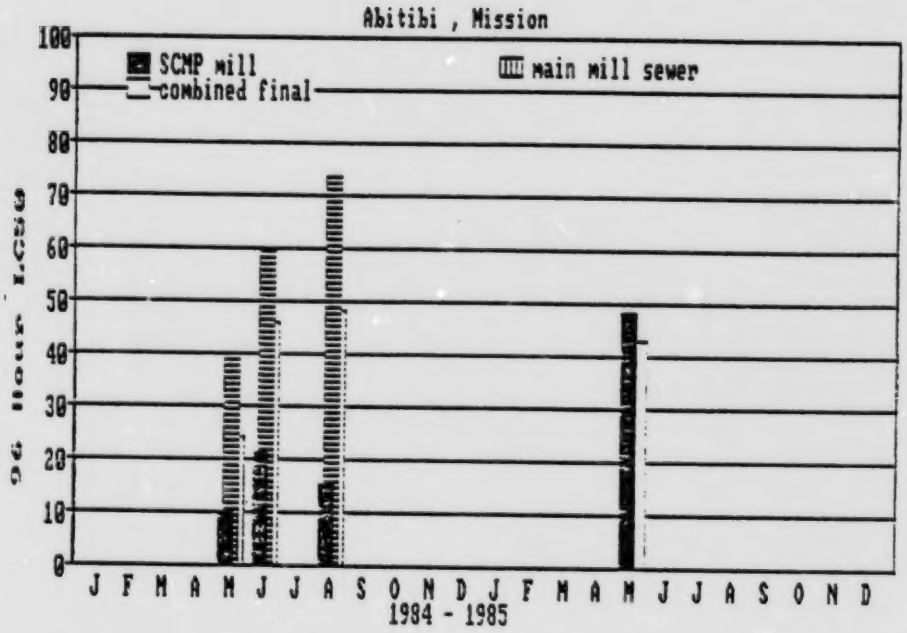
FORT WILLIAM
Mission Bay
Whiskyjack Point
FORT WILLIAM
Breakwater
Elevators
Oil Tanks
Gasoline
Race Track
Pulp Mill
City Limits
Creek
17



Abitibi , Mission

SAMPLE SITE	TYPE	DATE	LC50	REMARKS
Bark lagoon	isco composite	840507	10	less than 10 %
Bark lagoon	isco composite	840611	11	
Bark lagoon	isco composite	840808	13.4	
combined final	manual composite	840507	24	
combined final	4hr composite	840611	46	
combined final	manual composite	840611	53.2	
combined final	manual composite	840808	48.3	
combined final	24hr composite	850522	47.9	
combined final	24hr composite	850523	42.8	
combined final	24hr composite	850523	42.8	
main mill lagoon	manual composite	840507	40	
main mill sewer	manual composite	840611	59.6	
main mill sewer	manual composite	840808	73.7	
SCMP mill	manual composite	840507	10	less than 10 %
SCMP mill	manual composite	840611	21.4	
SCMP mill	manual composite	840808	15.1	
SCMP mill	grab	850523	48.3	
woodroom	24hr composite	850523	13.4	

Abitibi Price, Thunder Bay.Ft.William

SAMPLE SITE	TYPE	DATE	LC50	REMARKS
bark lagoon	4hr composite	830707	3.2	
bark lagoon	4hr composite	830819	4.8	
combined final	4hr composite	830707	25	
main lagoons	4hr composite	830707	48	
main sewer	5hr composite	830601	44	
main sewer	4hr composite	830819	45	
mill effluent	grab	790807	77.5	
mill effluent	4 hr. comp	800818	13	
mill effluent	4 hr. comp	800825	20	
mill effluent	4 hr. grab	800828	18	
mill effluent	grab	810408	38	
mill effluent	12 hr. comp	810630	54	
mill effluent	grab	810714	49	
mill effluent	grab	810810	50	
SCMP sewer	12 hr. comp	810630	14	
SCMP sewer	grab	810713	8	
SCMP sewer	grab	810804	2.2	
SCMP sewer	comp	810810	6	
SCMP sewer	5hr composite	830601	2.1	
SCMP sewer	4hr composite	830707	1	
SCMP sewer	4hr composite	830819	2.2	
woodroom	grab	790807	8.3	
woodroom	4 hr. comp	800818	5	
woodroom	4 hr. grab	800825	43	flushing lagoon
woodroom	4 hr. grab	800825	7	
woodroom	12 hr. comp	810630	7	
woodroom	grab	810714	11	

Abitibi Price Inc., Iroquois Falls Division, Iroquois Falls

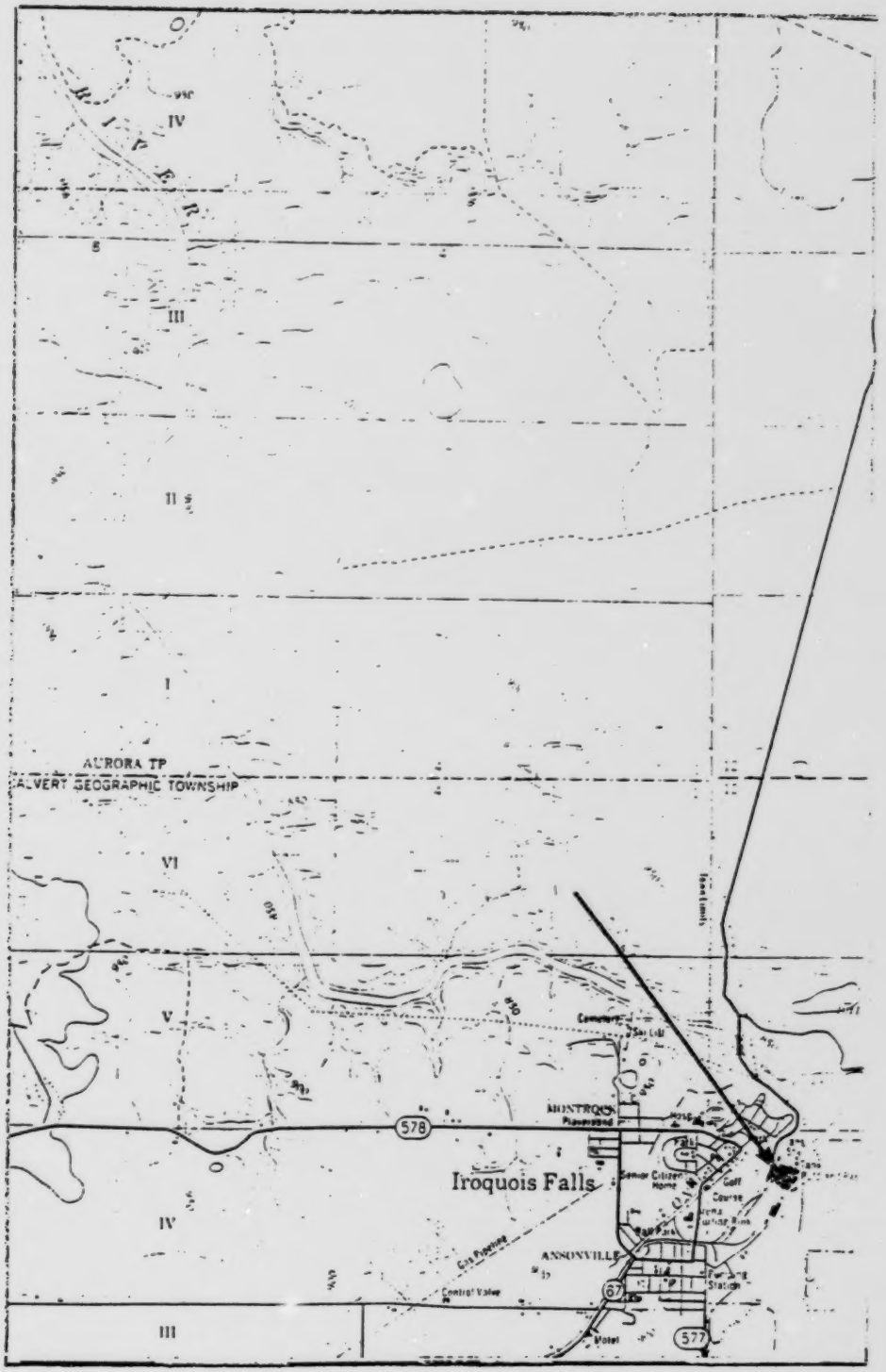
Abitibi Price, Inc., Iroquois Falls Division, Iroquois Falls

Receiving watercourse: Abitibi River (Moose River/To James Bay)

flow: 53327 cu m/day BOD: 47600 Kg/day
SS: 5300 Kg/day

High organic loading in spent sulphite liquor and woodroom causes the effluent to have an oxygen reducing demand on the river and is toxic to fish. Two of three trout bioassays, performed in 1985, indicated that it would take, statistically, 14% and 21% effluent to kill 50% of the fish by the end of four days exposure. The third bioassay showed the effluent to have been non-acutely lethal to fish. Water quality in the Abitibi River below the mill has been degraded by mill discharges, aggravated by low flow conditions which are controlled by the company's three hydroelectric power developments, two above and one below the mill. In the past, the river below the mill has suffered impairment from accumulated visible, settleable solids, fluctuating flows and oxygen depletion.

The mill was constructed in 1914-15 in conjuction with a series of three hydro-electric generating stations with a total capacity of 90 MW on the Abitibi River. In 1963 the low yield sulphite operation was converted to Arbiso high yield bisulphite pulping. In 1974, two 32.8 diameter clarifiers were installed. In 1978 Beak submitted an assimilative capacity study. The mill was renovated through replacement of four newsprint machines by one large new machine in 1983. In addition, there are three old paper machines. Softwood logs and chips are made into newsprint by wet drum debarking, sulphite pulping (62% yield), groundwood pulping, groundwood brightening and papermaking (2 paper machines). Bark screens and drainers, groundwood wastewater screens, systems were installed to reduce the total suspended solids load to the clarifiers and subsequently to the river.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ALVERT GEOGRAPHIC TOWNSHIP
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Iroquois Falls
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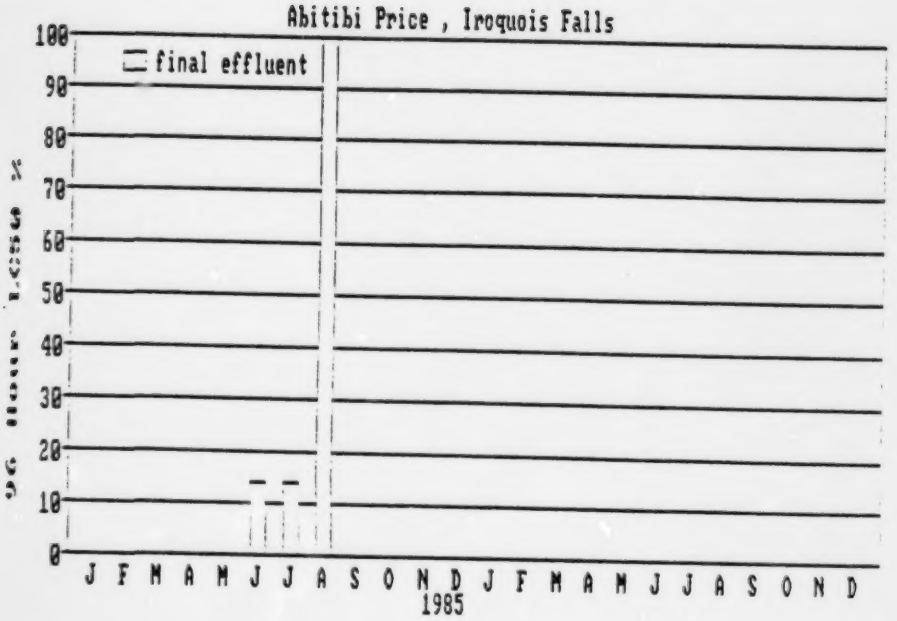


Abitibi Price,Iroquois Falls

SITE	TYPE	DATE	LC50	REMARKS
blowpit discharge	grab	760803	10	less than 10. %
blowpit discharge	grab	760803	10	less tha 10 %
final	grab	760308	42	
final	grab	760803	42	unaerated test
final	grab	801105	18	
final	grab	850603	14.2	
final	grab	850706	14.1	
final	grab	850708	21.4	
final	grab	850806	100	

Abitibi Price Inc., Smooth Rock Falls

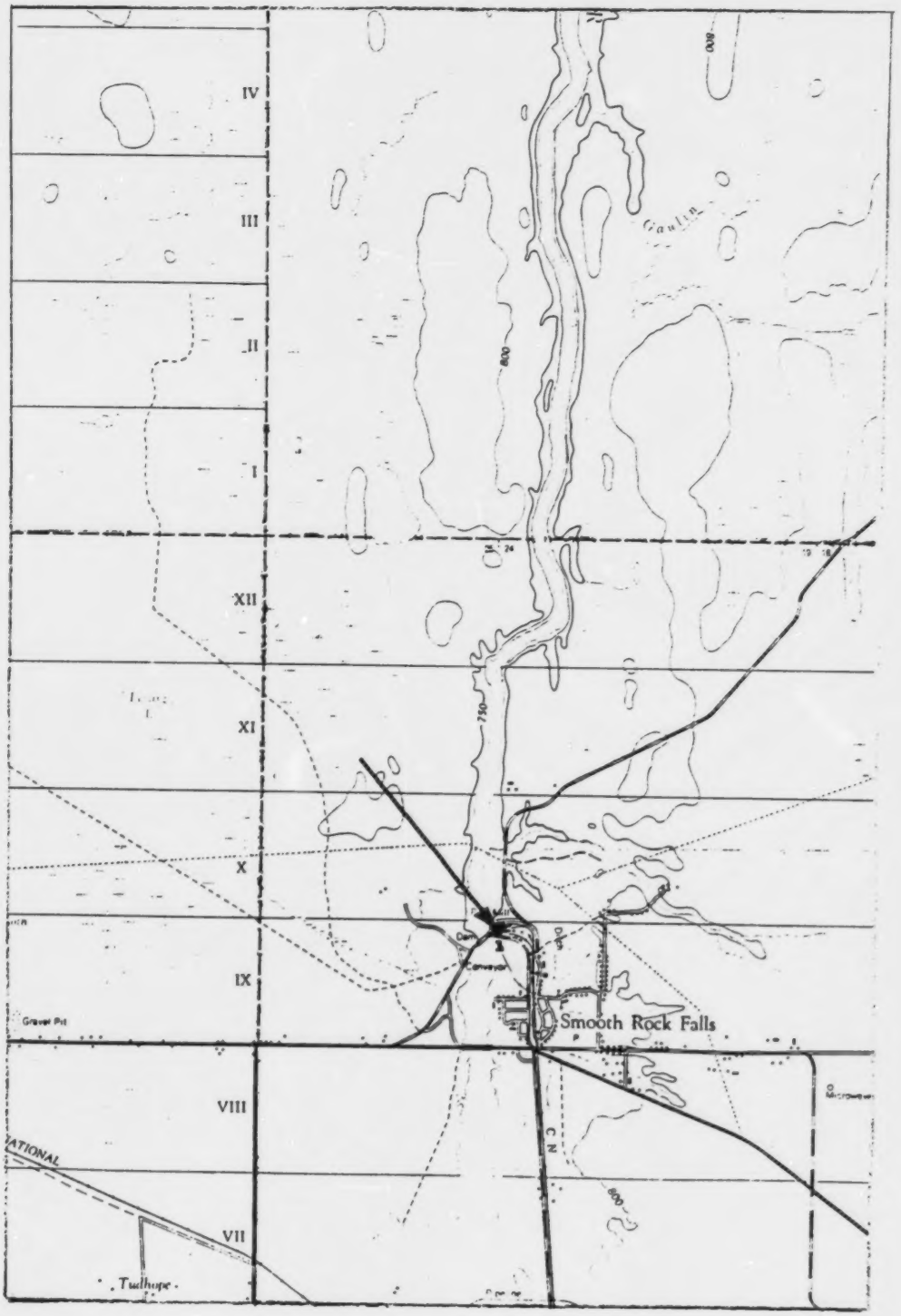
Abitibi Price, Inc., Smooth Rock Falls,

Receiving watercourse: Mattagami River (to James Bay)

flow: 47795 cu m/day	BOD: 7830 Kg/day
SS: 2480 Kg/day	DS: 40730 Kg/day
pH: 2.5-3.85	

Four trout bioassays, performed in 1985, indicated that it would take, statistically, 18%, 21%, 22% and 40% effluent to kill 50% of the fish by the end of four days exposure. The Mattagami River presently receives a large discharge of extremely toxic effluent which has the ability to taint fish flesh at sub-lethal concentrations. BOD_5 discharge from the mill may depress the dissolved oxygen concentration below 47% during the critical flow conditions. Although river surveys since 1969 indicated improved water quality, toxicity testing show little improvement. A 1982 survey indicated fish tainting 5 kilometers downstream. Intensive monitoring of downstream dissolved oxygen has recorded instances when the concentration has dropped below 47% saturation during critical low flow conditions.

The mill was originally built as a sulphite mill in the late 1920's and converted to kraft pulping in 1965. Logs and chips are made into bleached and unbleached kraft pulp. The mill consists of wet drum debarking, digesters/ cleaners/washers, beaching and pulp sheet formation. 2 x 4 studs (lumber) are also produced and the chips are used in the kraft mill. Stud logs are wet drum debarked at the pulp mill. In 1969, a foam retention lagoon was constructed to discharge through the diffuser pipes. In 1975, the diffuser pipes were extended, a primary effluent clarifier was constructed for the woodroom effluent with dewatering and burning of sludge in the refuse boiler. The mill has a knot reject recovery, wet bark recovery and primary effluent clarifier to reduce TSS discharge. A foam retention lagoon collects additional solids. Counter current washing and recycle throughout the mill reduces fibre loss. A fibre spill recovery system also reduces fibre loss. Twin diffuser pipes are used to discharge the final effluent to the Mattagami River. BOD_5 loadings have been reduced by increased brown stock washing, a black liquor spill control system, additional black liquor storage, and foul condensate stripping. Spent sulphuric acid from the bleach plant is presently recovered in the kraft recovery system to raise the depressed pH of the final effluent. In 1986 the mill was sold by Abitibi and is presently named Malettekraft Pulp and Paper.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Gauthier
Smooth Rock Falls
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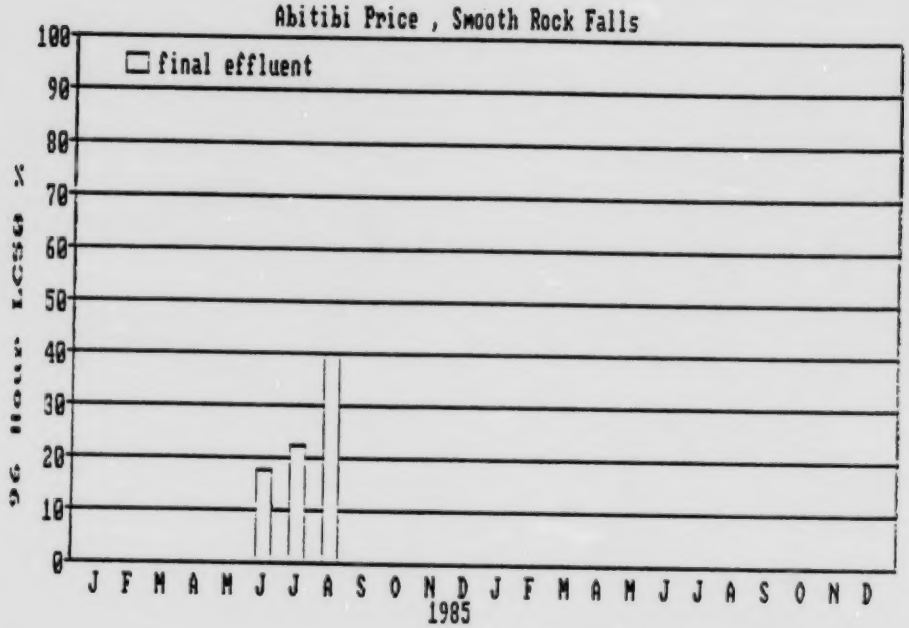


Abitibi Price, Smooth Rock Falls

SITE	TYPE	DATE	LC50	REMARKS
acid sewer	grab	830303	2.2	
acid sewer	grab	830303	2.2	
acid sewer	grab	830303	1	
acid sewer	grab	830303	2.2	
back ravine	grab	760727	21	unareated
back ravine	grab	760727	70	
clarifier	grab	830303	7.1	
clarifier	grab	830303	2.2	
final	grab	820617	17	
final	grab	820617	14	
final	grab	820619	14	
final	grab	820622	24	
final	grab	820827	20	
final	grab	820827	3.8	
final	grab	831006	16.5	
final	grab	850603	17.9	
final	grab	850603	21.4	
final	grab	850708	22.6	
final	grab	850806	40.1	

Abitibi Price, Smooth Rock Falls

SITE	TYPE	DATE	LC50	REMARKS
foam lagoon	grab	760706	20	unaerated
foam lagoon	grab	760706	37	
foam lagoon	grab	760720	10	less than 10 %
foam lagoon	grab	821118	14.1	
foam lagoon	grab	821119	10.7	
foam lagoon	grab	830202	10.7	
foam lagoon	grab	830202	0	
foam lagoon	grab	830202	3.8	
foam lagoon	grab	830202	7.1	
foam lagoon	grab	830202	0	
main sewer	grab	830303	11	
main sewer	grab	830303	7.1	
main sewer	grab	830303	2.2	

Abitibi Price Inc., Provincial Papers, Thunder Bay

Abitibi Price, Inc., Provincial Papers (Bare Point), Thunder Bay

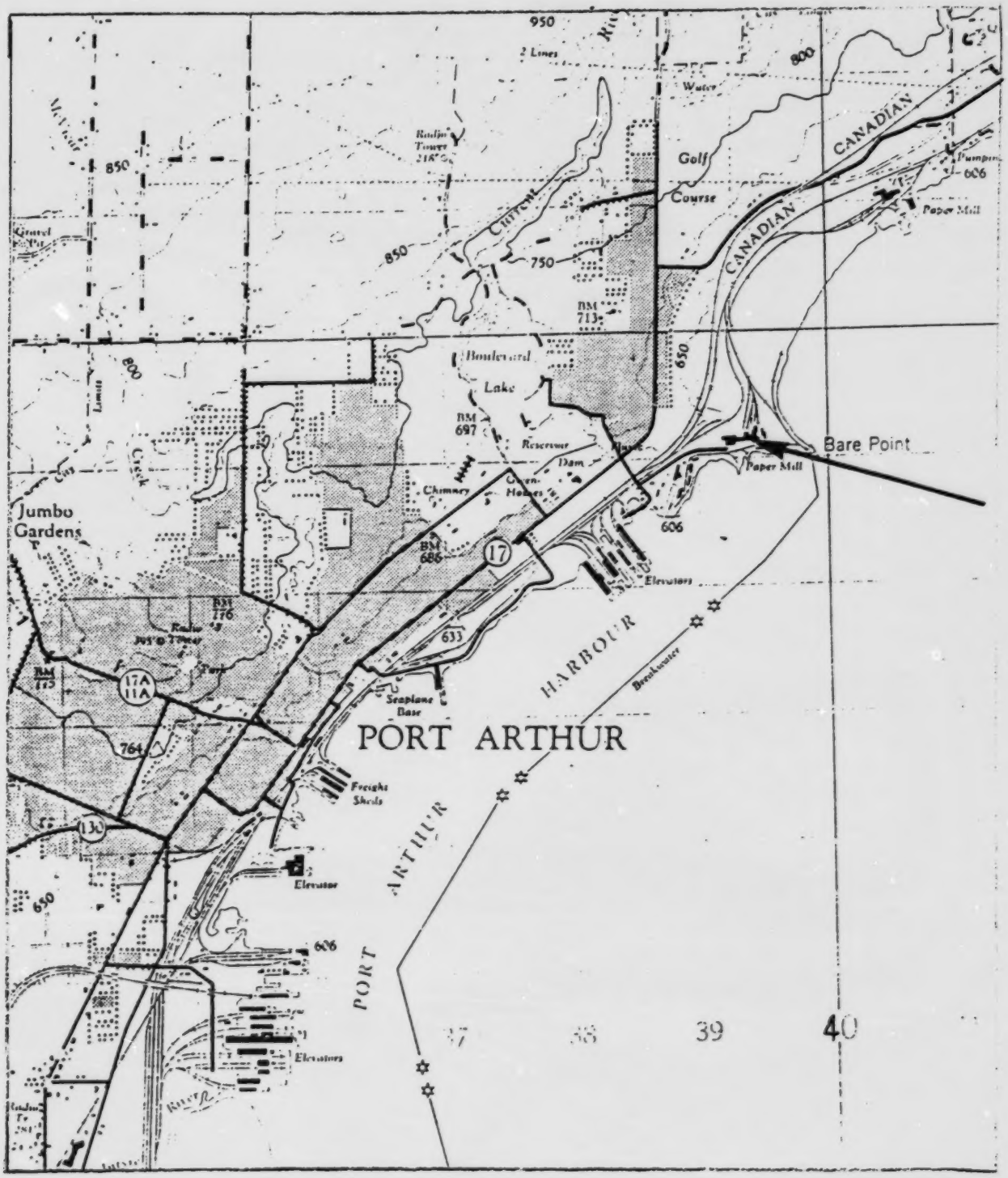
Receiving watercourse: Thunder Bay to Lake Superior

flow:	53400 cu m/day	BOD:	3950 Kg/day
PHOS:	2.86 Kg/day	SS:	1820 Kg/day

In 1985, the final sewer was tested once with the fish bioassay and was determined to have been non-acutely lethal. A 1972 Ministry survey indicated a significant shift in the species composition of aquatic organism in the vicinity of the outfall. Water quality continued to be adversely affected by wastewater discharges in the receiving body close to the mill and in addition the plume is highly visible due to clays and starches in the effluent.

The mill was constructed as a sulphite pulp mill in 1919 and began paper production in 1922. Stone groundwood pulping is in operation but the sulphite mill was shut down in 1978. Softwood logs, purchased pulp and additives (clay, starch) are made into fine papers. The mill consists of dry debarking, wood rewashers, groundwood pulping, groundwood bleaching (hydrogen peroxide) and fine papermaking. The product contains approximately 18% by weight starches and clay, and 45% purchased pulp.

An internal waste coating recovery system is used to recover clay. The company has put in a 75-foot diameter clarifier to treat high suspended solids streams. All of the mill effluent is directed into a settling lagoon prior to its discharge into Lake Superior. Settling lagoon was installed in 1970-71. Sanitary wastes are segregated and treated in rotor-disc system prior to discharge into the settling lagoon.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Paper Mill
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Boulevard
Lake
Reservoir
Dam
Chimney
Jumbo
Gardens
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686
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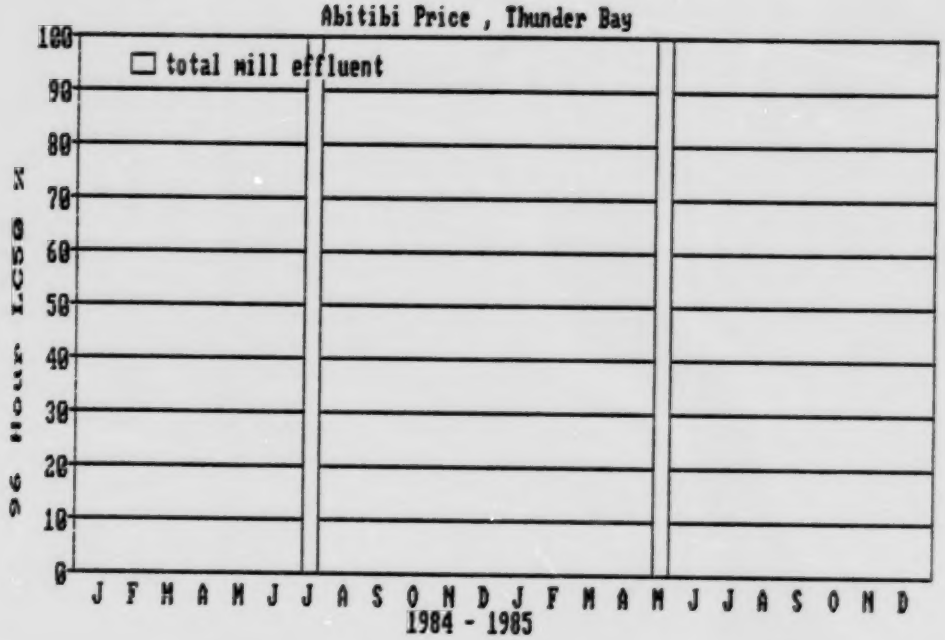


Abitibi Provincial Paper,Thunder Bay

Site	Type	Date	LC50	Remarks
fine paper mill effluent	grab	770725	14	LC 50 range 10-20 %
intake	grab	790807	100	non-lethal
total mill effluent	grab	770802	10	less than 10 %
total mill effluent	grab	790807	100	>100 %
total mill effluent	24 hr comp	800812	100	non-lethal
total mill effluent	24 hr comp	800826	100	non-lethal
total mill effluent	24 hr comp	800829	100	>100 %
total mill effluent	24 hr comp	810614	100	non-lethal
total mill effluent	4hr composite	830727	100	
total mill effluent	4hr composite	840710	100	
total mill effluent	24hr composite	850510	100	>100

Abitibi Price Inc., Thunder Bay Division, Thunder Bay

Abitibi Price, Inc., Thunder Bay Division, Thunder Bay

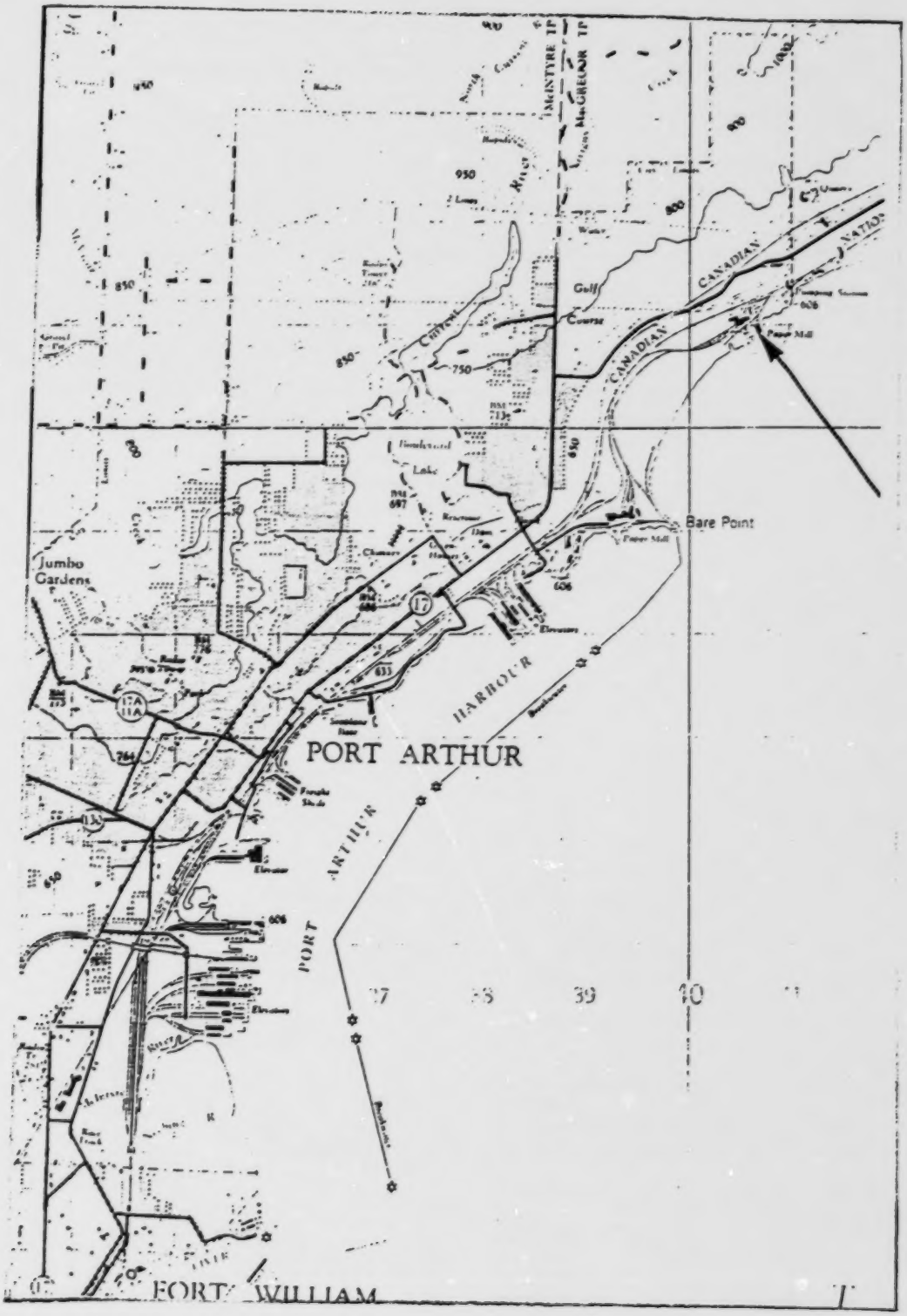
Receiving watercourse: Lake Superior

flow:	34800 cu m/day	BOD:	19000 Kg/day
PHOS:	8.84 Kg/day	SS:	1260 Kg/day

The groundwood mill effluent is extremely toxic to fish, while the paper mill effluent is non-lethal, making the combined effluent from the complex lethal to fish. Five trout bioassays, conducted in 1985 indicated the statistical estimate of the percentage effluent required to kill 50% of the fish by the end of four days exposure ranged from 10% to 40%. Water quality surveys indicate that the company's wastewater discharges have an effect upon Lake Superior.

Softwood logs are made into newsprint. The mill consists of wet drum debarking, sulphite pulping (66.3% yield), groundwood pulping, groundwood brightening and papermaking.

The company has installed spill collection systems throughout the mill to minimize losses. A 65-foot diameter clarifier was installed to treat high solid streams in 1981-82. All wastewaters are discharged into one of two parallel lagoons of 2.75 acres each for solids removal prior to discharge to Lake Superior; these settling lagoons were installed in 1970-71.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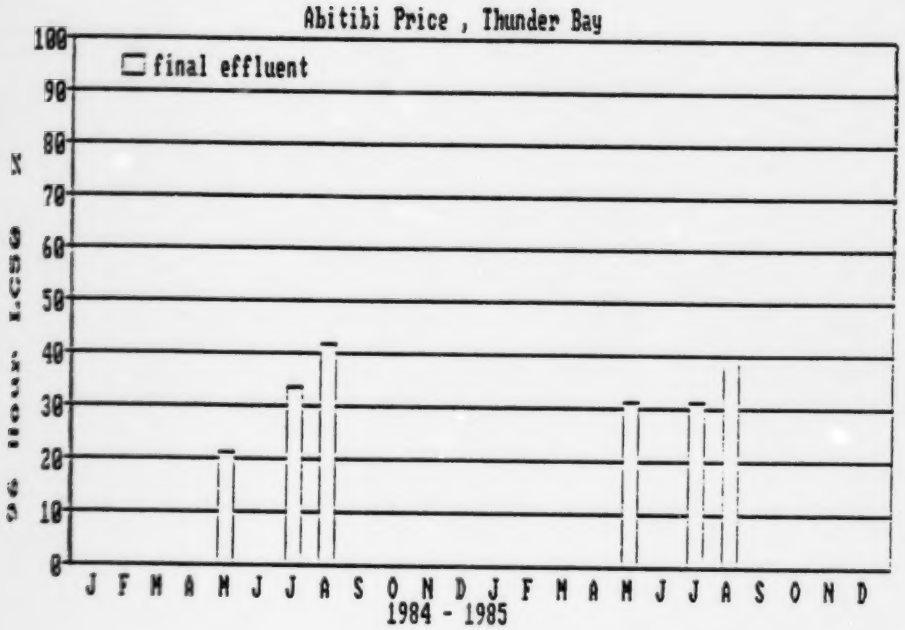


ABITIBI PRICE , THUNDER BAY

SAMPLE SITE	TYPE	DATE	LC50	REMARKS
final effluent	4hr composite	830615	22	:ph adjusted to 7.0
final effluent	3.5hr. composite	830622	14	:ph adjusted to 6.5
final effluent	3.5hr composite	830622	14	
final effluent	4hr composite	830727	100	:40% mortality at 100
final effluent	4hr composite	830727	14	
final effluent	4hr composite	830727	14	
final effluent	manual composite	840523	21.4	18.4 - 24.8
final effluent	manual composite	840717	33.7	28.3 40.2
final effluent	manual composite	840717	37.8	32.7 - 43.6
final effluent	manual composite	840820	42.8	37.9 - 48.3
final effluent	manual composite	840820	42.9	38.1 -48.3
final effluent	manual composite	840820	40.1	34.1 - 47.2
final effluent	4 hr. composite	840821	29.3	, soft 40.ppm water
final effluent	4 hr. composite	840821	44.4	, hard water dilution
final effluent	24hr composite	850509	31	
final effluent	24hr composite	850723	31.2	
final effluent	24hr composite	850723	10	<10
final effluent	24hr composite	850723	10	<10
final effluent	24hr composite	850806	40.1	34.1-47.2
pulp effluent	grab	770725	14	10-20 %
pulp effluent	24 hr. comp	800812	26	
pulp effluent	24 hr. comp	800826	22	
pulp effluent	24 hr. comp	800829	21	
pulp effluent	12 hr comp	810615	7	
pulp effluent	grab	810615	16	
pulp effluent	12 hr. comp	810615	13	
woodroom	grab	770802	14	10-20 %

The Beaver Wood Fibre Co. Ltd., Thorold

The Beaver Wood Fibre Co. Ltd., Thorold

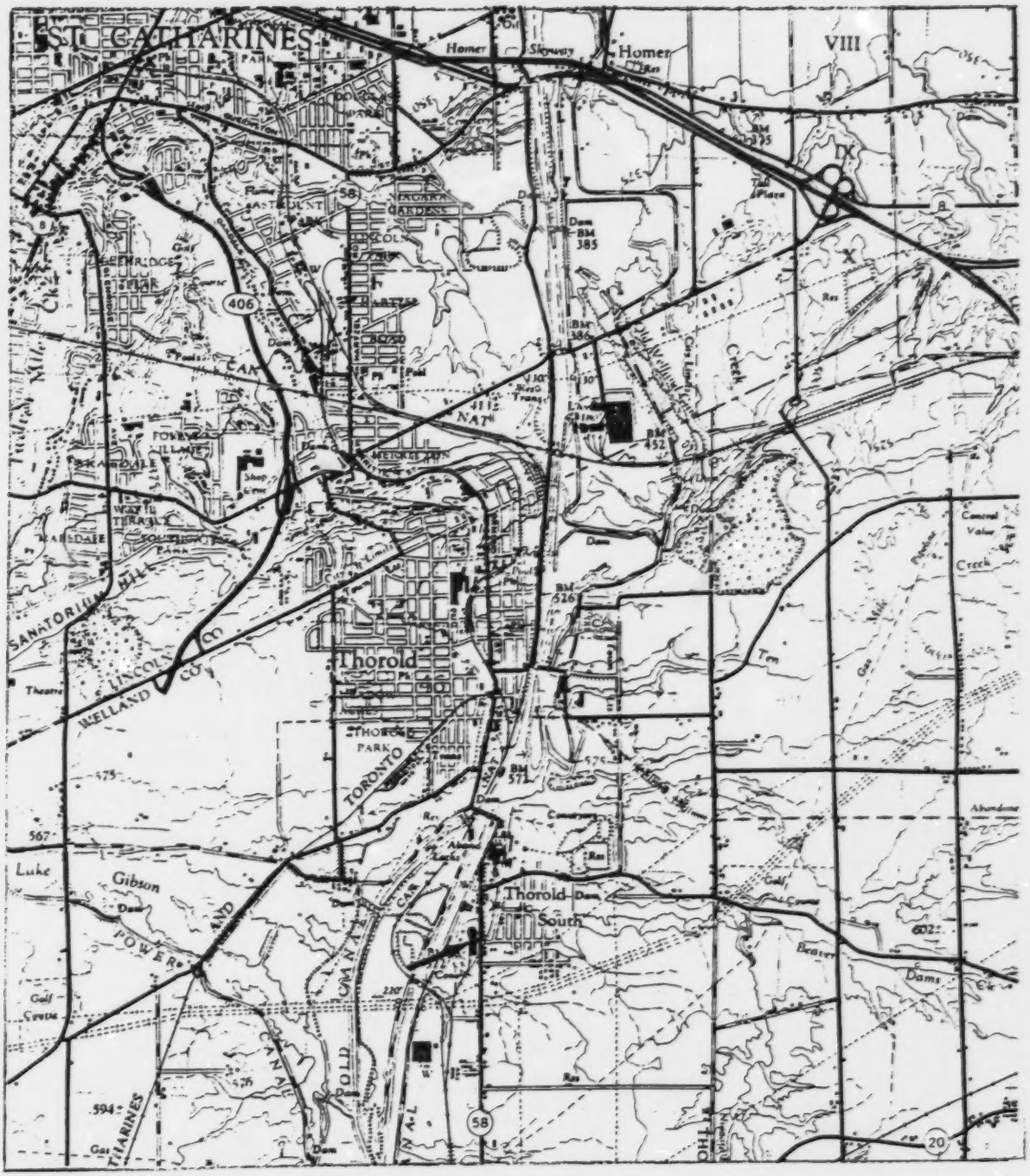
Receiving watercourse: Beaverdams Creek, Lake Gibson
(to Twelve Mile Creek to lake Ontario)

flow:	13990	cu m/day	BOD:	2950	Kg/day
DS:	3990	Kg/day	SS:	1590	Kg/day

The mill effluent is moderately toxic to fish. Two trout bioassays, performed in 1984, indicated that it would take, statistically, 62% and 81% effluent to kill 50% of the fish by the end of four days exposure.

Paper and paper products have been produced at this site since before 1900. Newsprint was produced from stone groundwood pulping and purchased pulp. Newsprint production ceased in 1976 and the newsprint machine was sold. Groundwood pulping from debarked cordwood ceased in 1976, also. Paperboard is made from purchased waste paper. The mill consists of repulpers cleaners and boxboard forming (cylinder machine).

Occasionally, the Ontario Hydro lowers the level of Lake Gibson and the aesthetic problem on the lake bed becomes highly visible. Foam and odour make the Beaverdam Creek unattractive as a water course. Effluent surges cause a high torque at the clarifier; to protect clarifier, effluent might by-pass clarifier and exceed TSS limit. Further reduction is needed for both the solids and BOD to 15 p.p.m. and for reducing the generation of foam in Beaverdam Creek. The City of St. Catharines is considering the use of Lake Gibson as their source of drinking water. A second clarifier may be required to handle scheduled clarifier maintenance or a clarifier emergency shutdown. To contain surges, the mill modified a stock chest in 1984. One circular primary clarifier is used on total mill effluent with sludge return to the stock system. Water recycle at paper machine is used to reduce TSS before final clarifier.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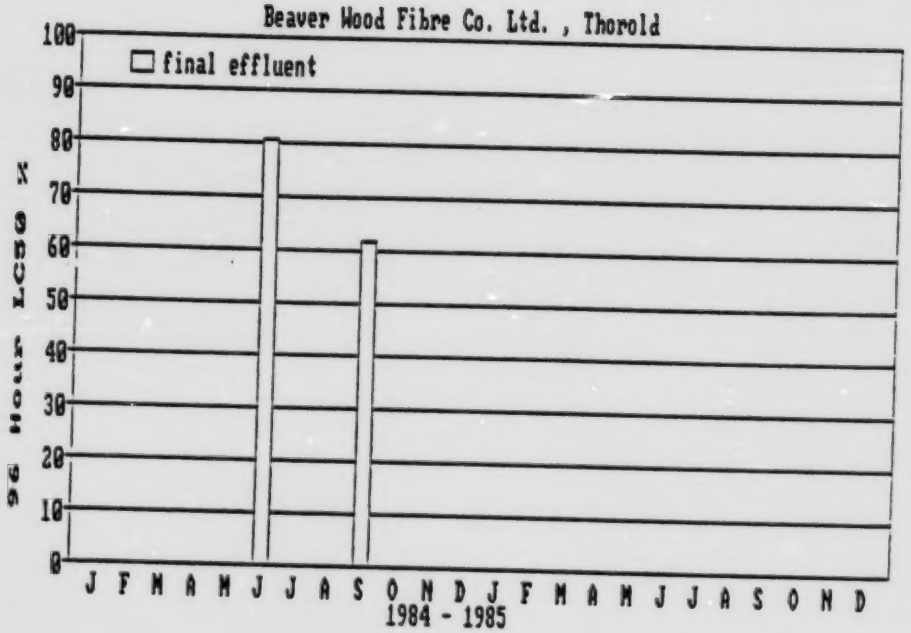


Beaver Wood Fibre Co. Ltd , Thorold

Site	Type	Date	LC50	Remarks
beaver dam's ck (upstream)	grab	800423	100	greater than 100 %
beaver dam's ck(downstream	grab	800423	70	
final effluent	grab	760517	60	
final effluent	grab	760517	60	unaerated
final effluent	grab	800423	81	
final effluent	grab	801007	100	greater than 100%
final effluent	grab	840625	80.6	
final effluent	grab	840919	61.6	

Boise Cascade Canada Ltd., Fort Frances

Boise Cascade Canada Ltd., Fort Frances.

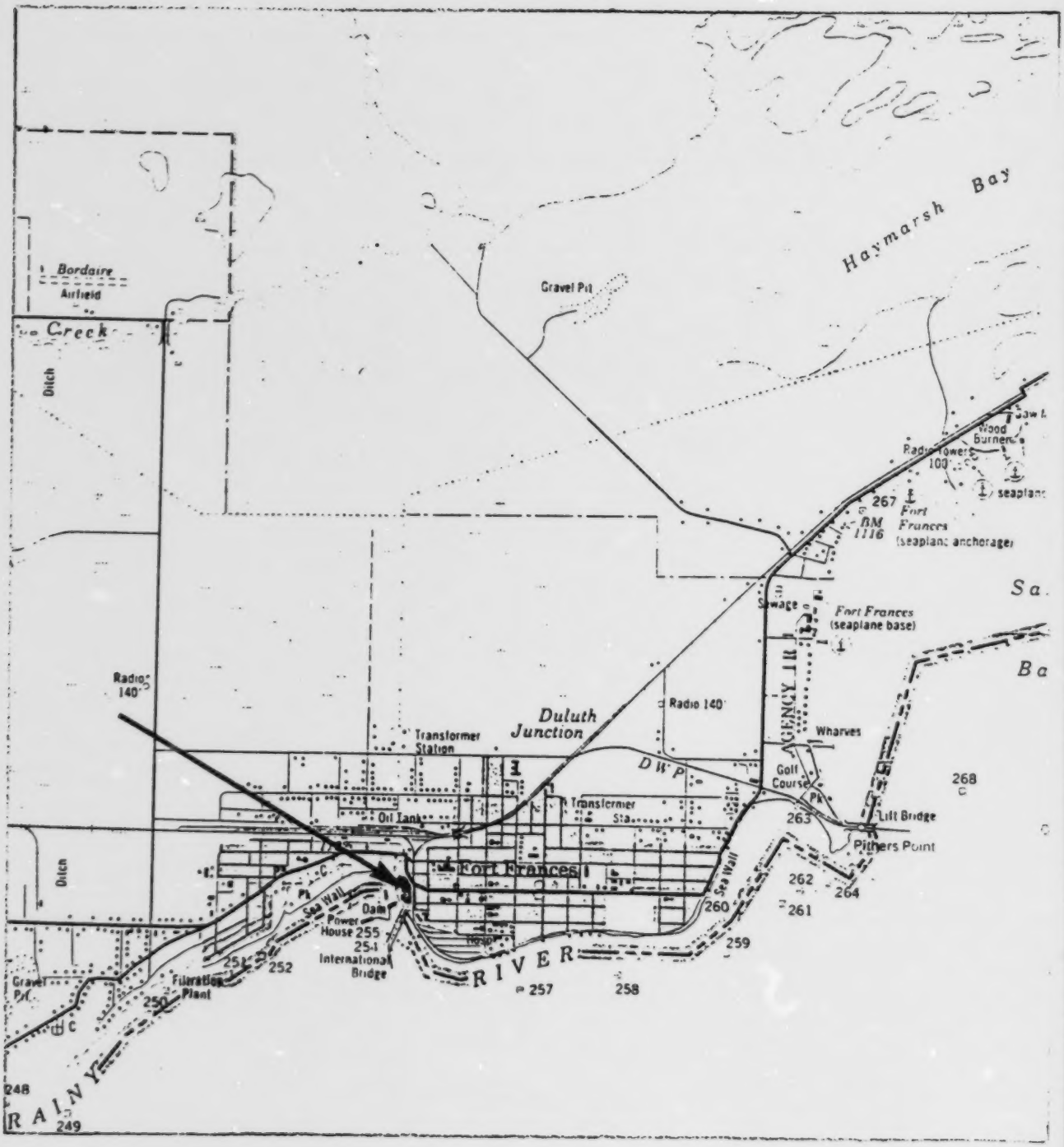
Receiving watercourse: Rainy River (to Lake of the Woods/Arctic)

flow: 71100 cu m/day BOD: 12070 Kg/day
SS: 6080 Kg/day

The total mill effluent is usually toxic to fish. One of five bio-assays conducted in 1985 indicated the effluent was non-lethal, however, the remaining indicated that, statistically, the percentage effluent required to kill 50% of the fish by the end of four days exposure ranged from 12% to 21%. The toxicity of the total mill effluent decreased during 1982 but is still lethal to fish. This was due to improved in-plant controls more spill control, better pH control) and increased aeration in the secondary treatment system. A major portion of the Rainy River is unfit for water contact recreation because of the mills' discharges and because of agricultural wastes. Excessive bacterial loadings may require further evaluation. A large Boise Cascade pulp and paper plant in International Falls, Minnesota, also discharges treated effluents to the receiving stream. A 1969 water quality survey, made for the I.J.C. Rainy River Water Pollution Board, found that the river could handle a maximum BOD loading of 70,000 lbs/day from all sources. The mill is still a source of odour problems. Research is needed on the fate of chlorinated organics in the receiving waters.

Formerly Ontario-Minnesota Pulp and Paper, the first pulping process was groundwood. A 500 ton/day kraft mill was added in 1971.

Effluent treatment systems consist of a bark fines system with clarifier on wet woodroom effluent; disk filter, saveall and primary clarifier for paper mill effluent; segregation of uncontaminated vacuum seal waters; primary and secondary treatment of the total effluent after September, 1983. A clarifier treats paper mill effluent, the primary-aeration basins treat kraft mill, the wet woodroom and clarified paper machine effluents.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Ditch
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Radio Towers
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Wood Burners
seaplane
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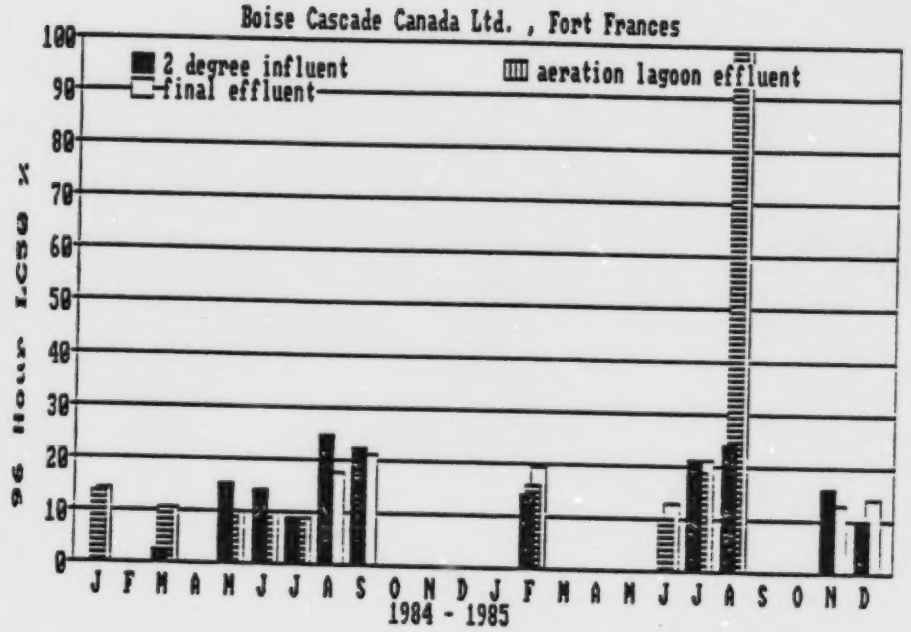
Fort Frances
(seaplane anchorage)
Sewage
Fort Frances
(seaplane base)
Radio 140'
Duluth Junction
Transformer Station
Radio 140'
AGENCY
Wharves
Golf Course
Pk
268
263
Lift Bridge
Pithers Point
Oil Tank
Transformer Sta.
Fort Frances
Ditch
Pk
Sea Wall
Dam
Power House 255
25-1
International Bridge
Sea Wall
262
264
261
260
259
Gravel Pit
Filtration Plant
250
252
257
258
RAINY RIVER
248
249



Boise Cascade Canada Ltd , Fort Frances

Site	Type	Date	LC50	Remarks
2 degree influent	grab	810622	19	
2 degree influent	grab	810706	11	
2 degree influent	4hr composite	830613	8	
2 degree influent	4hr composite	830802	7	
2 degree influent	grab	840301	2.5	
2 degree influent	manual composite	840524	15.1	13.0-25.3%
2 degree influent	4Hr. composite	840525	24.5	
2 degree influent	manual composite	840619	14.2	12.7-15.9%
2 degree influent	grab	840719	8.6	
2 degree influent	manual composite	840814	24.9	17.0-36.6
2 degree influent	manual composite	840829	22.6	20.3-25.3%
2 degree influent	grab	850211	14.1	
2 degree effluent	grab	850617	13.4	
2 degree influent	grab	850715	21.4	
2 degree influent	grab	850806	24	
2 degree influent	24hr composite	851118	12.7	
2 degree influent	24hr composite	851118	16.3	13.0-20.4%
Aeration Lagoon Effluent	grab	800708	3.5	
Aeration Lagoon Effluent	grab	800722	8	
Aeration Lagoon Effluent	grab	800822	5	
Aeration Lagoon Effluent	grab	810622	6	
Aeration Lagoon Effluent	grab	810706	16	
Aeration Lagoon Effluent	grab	810804	45	

Boise Cascade Canada Ltd , Fort Frances

Site	Type	Date	LC50	Remarks
Aeration Lagoon Effluent	4hr composite	830613	11	
Aeration Lagoon Effluent	4hr composite	830802	7	
Aeration Lagoon Effluent	4hr composite	830829	13	
Aeration Lagoon Effluent	4Hr. composite	840125	13.7	
Aeration Lagoon Effluent	grab	840301	10.7	
Aeration Lagoon Effluent	manual composite	840524	10	less than 10%
Aeration Lagoon Effluent	manual composite	840619	10	less than 10 %
Aeration Lagoon Effluent	manual composite	840717	10	less than 10 %
Aeration Lagoon Effluent	manual composite	840717	10	less than 10 %
Aeration Lagoon Effluent	grab	840719	8.9	
Aeration Lagoon Effluent	grab	850211	15.6	
Aeration Lagoon Effluent	grab	850617	10	<10
Aeration Lagoon Effluent	grab	850715	19	
Aeration Lagoon Effluent	grab	850806	100	>100
Aeration Lagoon Influent	grab	800708	7	
Aeration Lagoon Influent	grab	800722	5	
Aeration Lagoon Influent	grab	800806	4	
Aeration Lagoon Influent	grab	810622	15	
Aeration Lagoon Influent	grab	810706	14	
Aeration Lagoon Influent	4Hr. composite	840125	14.5	
Clarifier	grab	800708	11	
Clarifier	grab	800722	14	
Clarifier	grab	800806	13	
Clarifier	grab	810622	8	
Clarifier	grab	810706	20	
Clarifier	grab	810804	14	
final effluent	grab	770726	10	10% LT100 48 hrs
final effluent	grab	790813	32	
final effluent	grab	800708	4	
final effluent	grab	800722	9	
final effluent	grab	800806	6	
final effluent	comp.- grab	810622	6	
final effluent	grab	810706	14	
final effluent	comp.- grab	810804	21	
final effluent	4hr composite	830725	13	
final effluent	4Hr. composite	840125	14	
final effluent	grab	840305	10.7	
final effluent	manual composite	840524	10	less than 10 %
final effluent	manual composite	840524	10	less than 10 %
final effluent	manual composite	840619	10	less than 10 %
final effluent	manual composite	840620	10	less than 10 %
final effluent	grab	840620	13.2	
final effluent	manual composite	840621	10	less than 10 %
final effluent	manual composite	840621	10	less than 10 %
final effluent	manual composite	840717	10	less than 10 %
final effluent	grab	840719	8.8	
final effluent	manual composite	840814	31.7	23.2-43.4%
final effluent	grab	840816	17.5	4.0ppm dilut. water
final effluent	grab	840816	17.9	135ppm dilut.water
final effluent	manual composite	840829	21.3	17.5-26.1%
final effluent	grab	850211	19.6	
final effluent	grab	850617	12.7	
final effluent	grab	850715	21.4	
final effluent	grab	850806	93.1	
final effluent	composite	850806	100	>100
final effluent	24hr composite	851118	13.4	

Boise Cascade Canada Ltd , Fort Frances

Site	Type	Date	LC50	Remarks
Intake	grab	790813	100	non-lethal
K2 aeration lagoon	4Hr. composite	840525	5.8	
Kraft Mill Bleaching	grab	810622	7	
Kraft Mill Bleaching	grab	810706	51	
paper mill clarifier	4hr composite	830613	19	
paper mill clarifier	4hr composite	830802	9	
paper mill clarifier	4hr composite	830829	14	
settling basin effluent	4hr composite	830613	5	
settling basin effluent	4hr composite	830802	6	
total plant effluent	4hr composite	830613	14	
total plant effluent	4hr composite	830802	8	
total plant effluent	4hr composite	830829	15	
Vacuum Pump Seals Water	grab	810622	100	greater than 100%
Vacuum Pump Seals Water	grab	810706	100	non-lethal
Woodroom Clarifier	grab	810622	7	
Woodroom Clarifier	grab	810706	4	

Boise Cascade Canada Ltd., Kenora

Boise Cascade Canada Ltd., Kenora

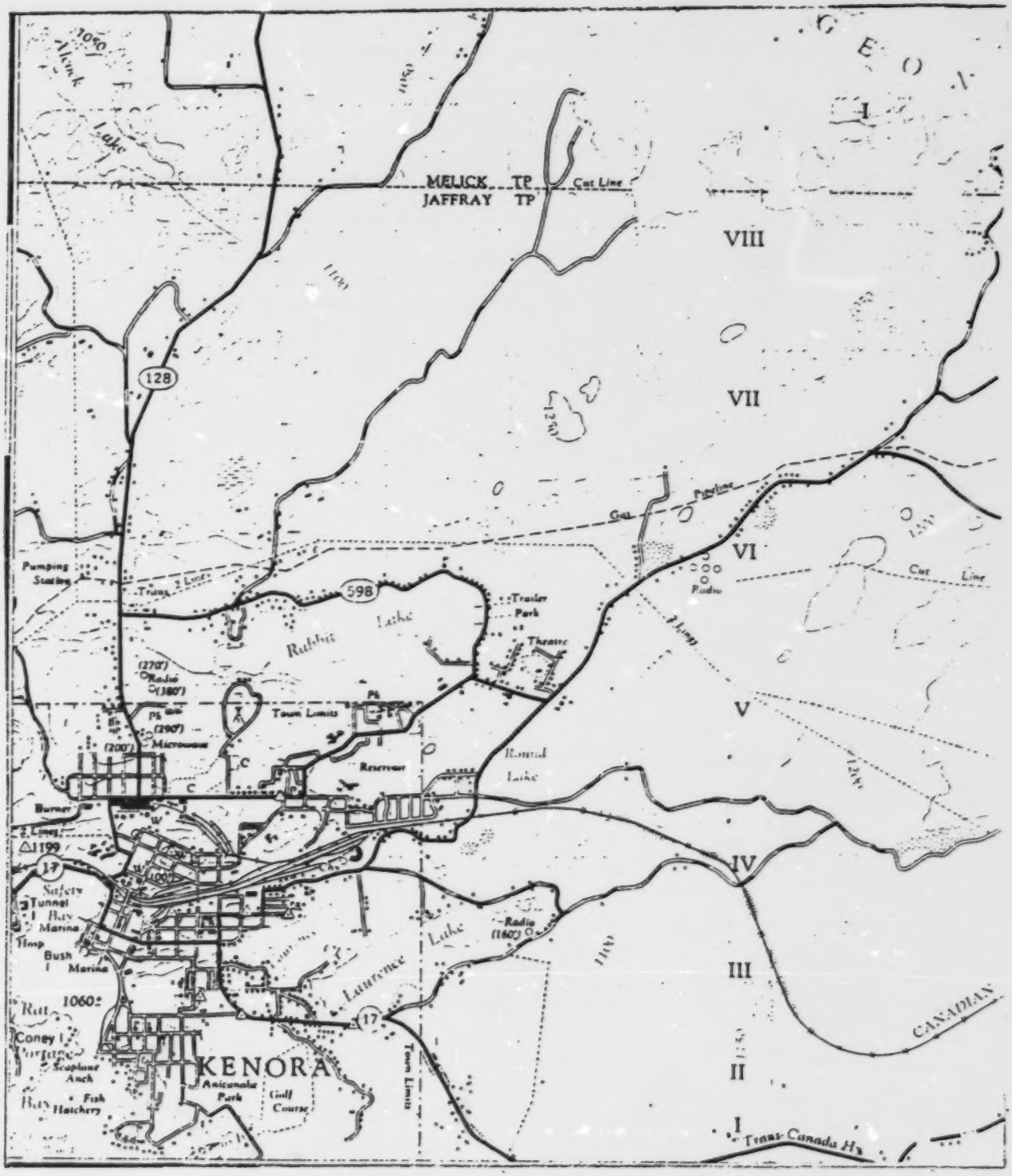
Receiving watercourse: Winnipeg River (Lake Winnipeg/Arctic watershed)

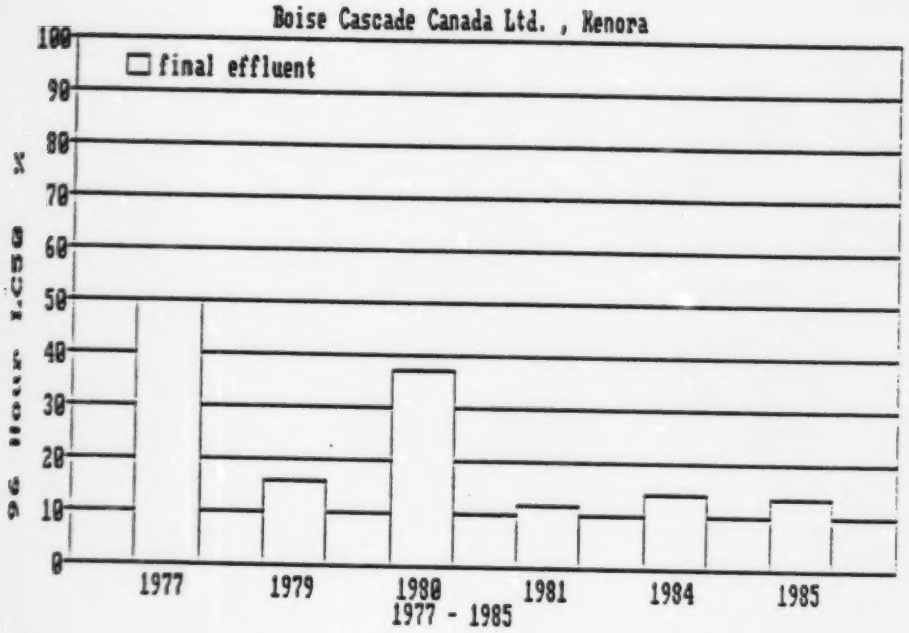
flow: 52300 cu m/day BOD: 25000 Kg/day
SS: 8660 Kg/day

This discharge is highly toxic to fish. A trout bioassay conducted in 1985, indicated that it would take, statistically 13.4% effluent to kill 50% of the fish by the end of four days exposure.

This mill has grown from a lumbering operation to the present 3-machine newsprint operation furnished with sulphite and groundwood pulp produced on site. Newsprint is presently made from logs and chips by the stone groundwood and sulphite processes respectively with some purchased softwood kraft.

A wet wood room has been replaced by a dry debarking facility. A clarifier handles paper mill effluent and sulphite high solids streams. High solid by-pass streams are treated for solids control by two bare 120-mesh screens. The total effluent is discharged through a diffuser outfall.


MELICK TP
JAFFRAY TP
Cut Line
VIII
VII
VI
V
IV
III
II
I
128
598
17
Rabbit Lake
Round Lake
Laurence Lake
Town Limits
Reservoir
Trailer Park
Theatre
Pumping Station
Safety Tunnel
Bay Marina
Bush Marina
Coney Island
Seaplane Anch
Fish Hatchery
Anicinabe Park
Golf Course
KENORA
CANADIAN
Trans-Canada Hy



Boise Cascade Canada Ltd , Kenora

SAMPLE SITE	TYPE	DATE	LC50	REMARKS
Final Effluent	grab	770725	50	
Final Effluent	24 hr comp.	791119	16	
Final Effluent	grab	800715	24	
Final Effluent	grab	800728	37	
Final Effluent	grab	800811	36	
Final Effluent	5 hr comp.	810615	12	
Final Effluent	5 hr comp.	810713	13	
Final Effluent	5 hr comp.	810817	11	
Final Effluent	4hr composite	840802	14	
Final Effluent	24hr composite	851202	13.4	
Mg Sulfite	24 hr comp.	791911	3	LC50 range 1.8-5 %
Mg Sulfite	5 hr comp.	810615	3.6	
Mg Sulfite	5 hr comp.	810713	4	
Mg Sulfite	5 hr comp.	810817	7	
Raw Water	grab	791120	100	non-lethal
White Water Clarifier	grab	791120	24	LC50 range 18-33 %
White Water Clarifier	grab	800715	42	
White Water Clarifier	grab	800728	39	
White Water Clarifier	grab	800811	29	
White Water Clarifier	5 hr comp.	810615	18	
White Water Clarifier	5 hr comp.	810706	14	
White Water Clarifier	5 hr comp.	810817	8	

Domtar Construction Materials Ltd., Thorold

Domtar Construction Materials Ltd., Thorold

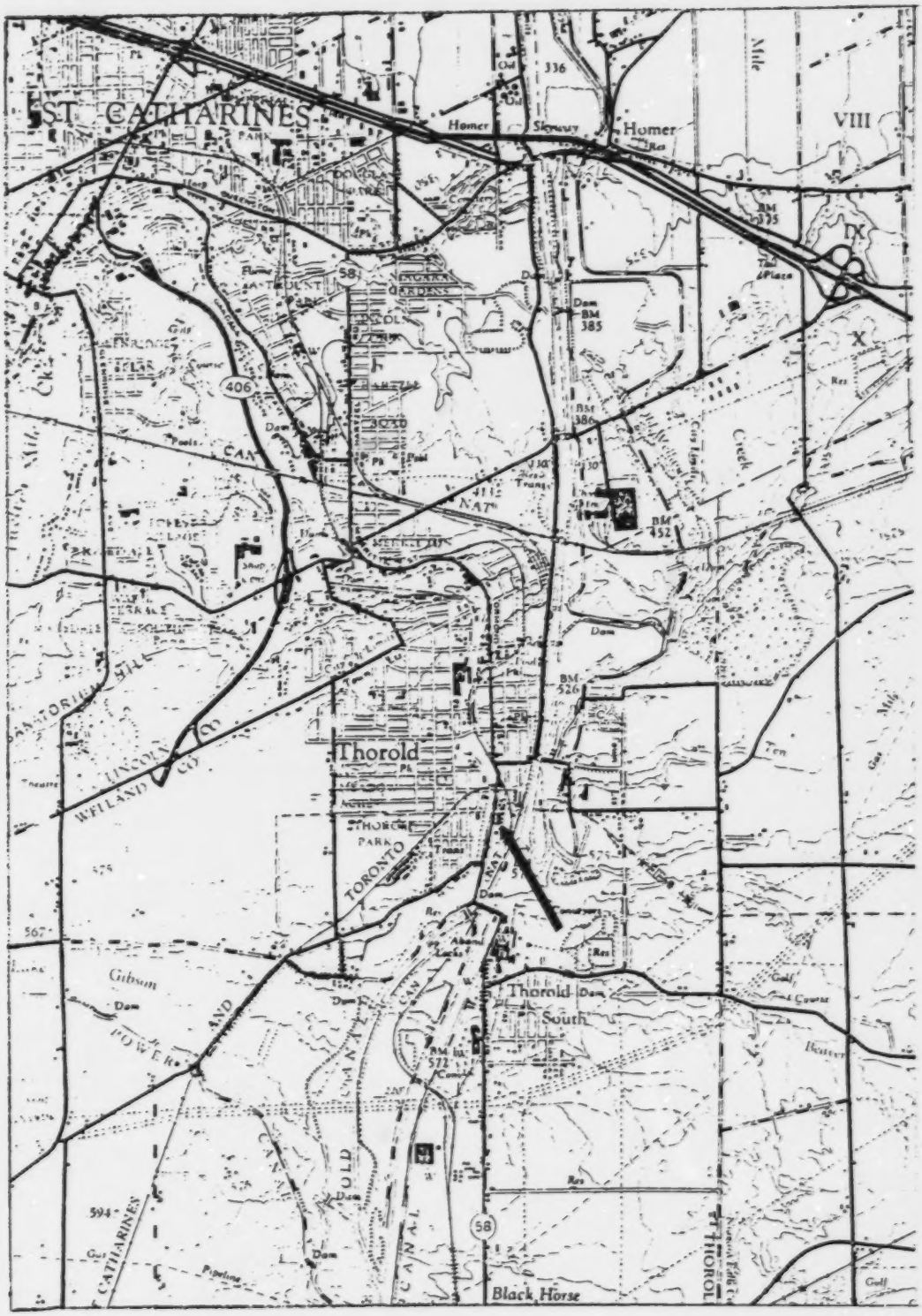
Receiving watercourse: Mill effluent connects via a buried sewer to a covered part of the Old Welland Canal and thence to Twelve Mile Creek and Lake Ontario.

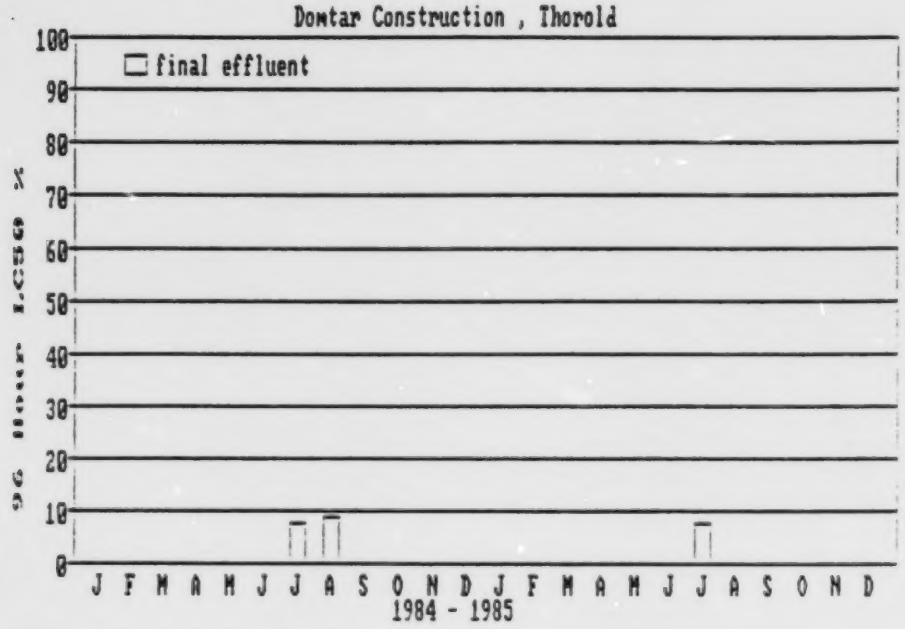
flow: 702 cu m/day BOD: 743 Kg/day
SS: 338 Kg/day

The mill effluent is toxic to fish. One trout bioassay conducted in 1985, indicated that it would take, statistically, 7.5% effluent to kill 50% of the fish by the end of four days exposure. High bacteria content may be a concern.

Product is made on one cylinder machine. Wood flour, made from wood shavings, is blended with waste paper to make the felt. In 1983 a computer controlled honeycomb dryer system was installed. Clean waste paper furnish is necessary to keep mill viable. Waste corrugating medium, wood floor (wastewood) and clean paper wastes are converted into a felt paper (construction paper) sheet. The mill consists of repulpers, grinders, cleaners, felt forming (cylinder machine) and tar coating process.

Controls consist of a conventional save-all and in-mill control by reusing paper machine and floor washings waters.


ST. CATHARINES
Homer
Homer
VIII
IX
X
406
Thorold
Thorold South
Black Horse
WELLAND CO
TORONTO
Gibson
POWER
CANAL
58
336
Creek



Domtar Construction , Thorold

Site	Type	Date	LC50	Remarks
final effluent	grab	800423	30	
final effluent	grab	801209	14	
final effluent	grab	840725	7.6	
final effluent	grab	840928	8.7	low DO 1.7
final effluent	grab	850726	7.5	

Domtar Fine Papers Ltd., Cornwall

Domtar Fine Papers Ltd., Cornwall.

Receiving watercourse: St. Lawrence River (Upstream of Montreal)

flow:	113000	cu m/day	BOD:	17100	Kg/day
DS:	116000	Kg/day	SS:	9430	Kg/day

The mill discharge is normally toxic to fish. Two of three trout bioassays, performed in 1984, indicated that it would take, statistically, 55%, and 81% effluent to kill 50% of the fish by the end of four days exposure. The third bioassay showed the effluent to have been non-acutely lethal to fish. Occasionally PCB's have been detected in the effluent. Research is needed on the fate of chlorinated organics in the receiving waters. Klebsiella pneumonia are a concern because of high bacterial populations downstream from the mill. Improvements in the existing diffuser have resulted in better dispersion but the plume remains detectable for 18 kilometers downstream. To a similar extent, phenolics above the water quality objective were noted but no tainting of fish or water supplies has been reported. The suspended solids discharge is near compliance.

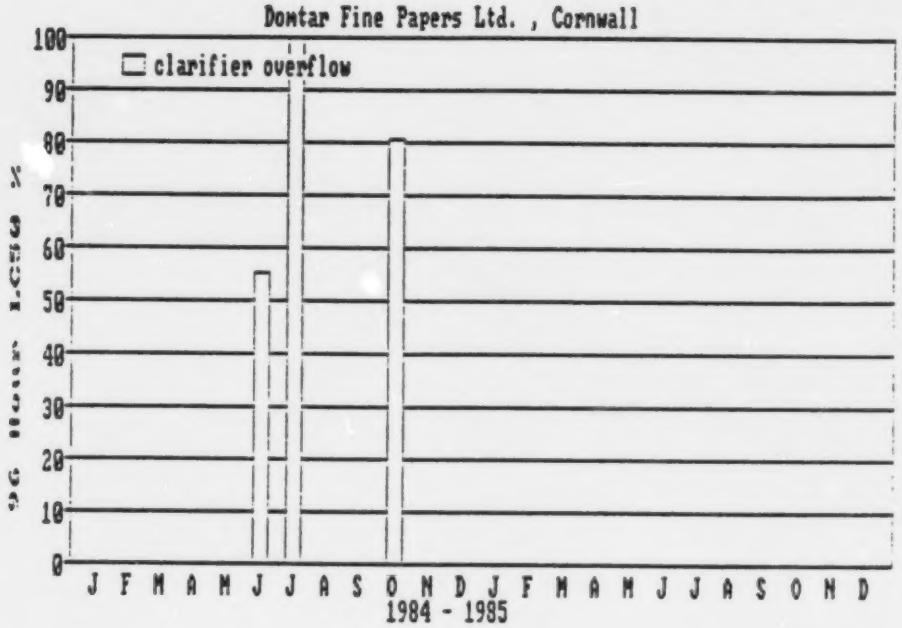
A sulphite pulp mill was added to the groundwood facility in 1888. A soda pulp mill started in 1927 and was converted to kraft in the 1940's. The sulphite mill was shut down in 1972. The mill now produces fine paper from logs and chips by the kraft pulping process and from purchased pulp.

1972 - sulphite mill shutdown eliminates spent chemical liquor from effluent - less organics and less toxic to fish.
- effluent eliminated from debarking room - less TSS, less organics and less toxics to fish.
- clarifier installed to remove TSS from high solids wastewaters.

1974 - steam stripper removes organics and toxics to fish from condensates.

1975-1985 - Copeland Reactor installed and operated to handle weak black liquor which reduces organics and compounds toxic to fish. Pulping operation capacity reduction in 1985 allows Copeland to be shutdown.

Glen Donald
Tyotown
Water Tower
Oil Tanks
Golf Course
CORNWALL
Faucett Air Service
Farlinger Point
Pilon Island
Colquhoun Island West
Hospital
Transformer
Navigation
Channel
Park
Swing Bridge
Power House
Roosevelt Bridge
Cornwall Island
ISLAND
INDIAN RESERVE
CORNWALL
ONTARIO
NEW YORK
CANADA
USA
QUEBEC
NY
STORMONT CO
HUNTINGDON CO
Hen Island
Uscan
St Regis
RES



Domtar Fine Papers Ltd , Cornwall

Site	Type	Date	LC50	Remarks
clarifier overflow	grab	760723	76	LC50 range 56-100 %
clarifier overflow	grab	770628	94	
clarifier overflow	grab	801015	77	
clarifier overflow	grab	810714	59	
clarifier overflow	grab	840619	55.1	
clarifier overflow	grab	840726	100	non-lethal
clarifier overflow	grab	841018	80.6	

Domtar Fine Papers Ltd., St. Catharines

Domtar Fine Papers Ltd., St. Catharines

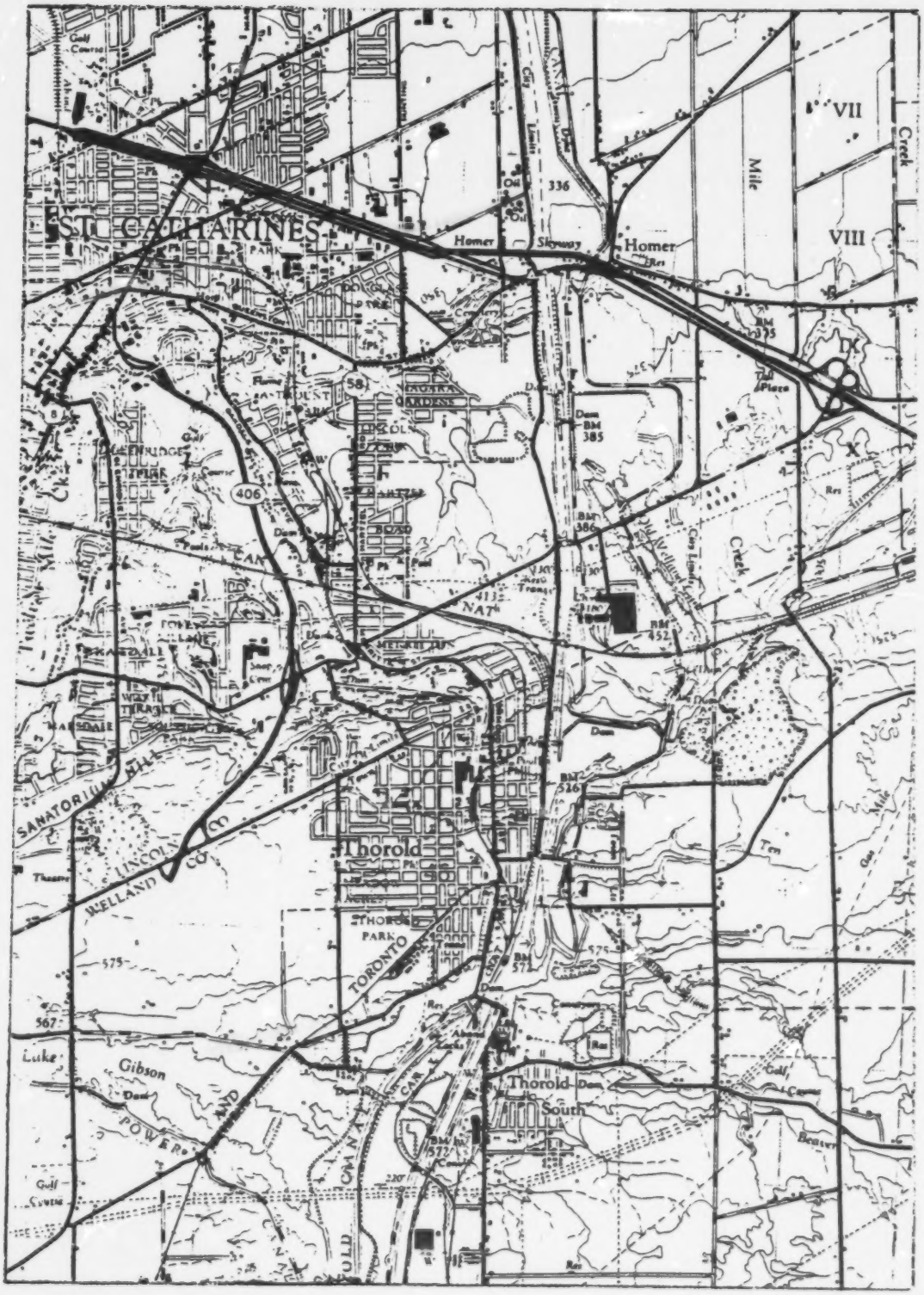
Receiving watercourse: Old Welland Canal, discharges to an open section of the Old (second) Welland Canal and thence to Twelve Mile Creek and Lake Ontario.

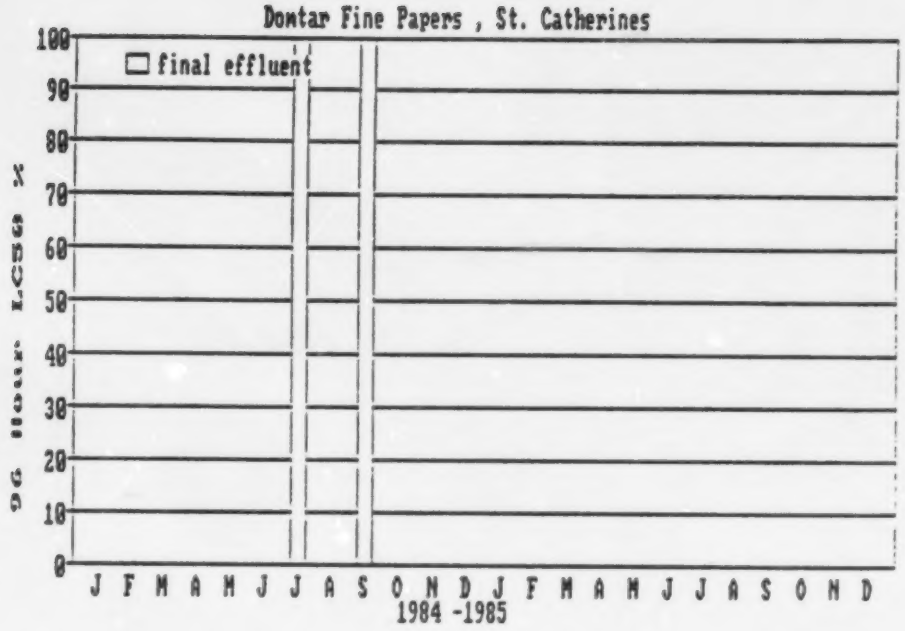
flow:	9274	cu m/day	BOD:	490	Kg/day
DS:	2960	Kg/day	SS:	246	Kg/day

The mill effluent normally does not kill fish. Two trout bioassays, performed in 1984, indicated the effluent to have been non-acutely lethal to fish. High bacteria counts of Klebsiella pneumoniae and Pseudomonous aeruginosa are found in the Old Welland Canal. Sources were identified by West Central Region staff in 1984 survey. Secondary effluent treatment may be required on selected waste waters to reduce BOD_5. A second clarifier may be needed to handle emergency shutdowns of the existing clarifier or scheduled clarifier maintenance. The discharge of effluent from five pulp and paper mills into the Old Welland Canal is an aesthetics problem.

The mill evolved from operations going back prior to 1900. The original pulping operation has been replaced by purchased pulp and clean wastepaper. Economic viability of the mill depends upon cheap wastepaper. Pulp and waste paper are converted into fine paper. The mill consists of repulpers, cleaners and paper machines.

Mill must substitute clean waste paper for purchased pulp for survival. The aesthetic problem of the Old Welland Canal is highly visible due the development of recreational trails along the canal route. The BOD loading is still above the interim objective set in the Program Approval. Conventional clarifier and aggressive in-mill control approach such as several different save-all screens, repiping the various water streams to recycle water at the paper machines, using different shower heads at the paper machines, etc. is used to control TSS. Effluent abatement consists of clarifier, reduced water usage and in-mill control. A switch was made to converted starch to reduce BOD.


ST. CATHARINES
Homer
Homer
Skyway
VII
VIII
Mile
Creek
Thorold
Thorold South
Gibson
Lake
Welland Canal
Power Rd
Toronto
Welland Co
Lincoln Co
Sanatorium Hill
406
336
575
567



Domtar Fine Papers , St. Catherines

Site	Type	Date	LC50	Remarks
Final	grab	800423	30	
Final	grab	801007	90	
Final	grab	811201	100	non-lethal
Final	grab	840710	100	: non-lethal
Final	grab	840928	100	

Domtar Inc. (Packaging), Trenton

Domtar Inc. (Packaging), Trenton

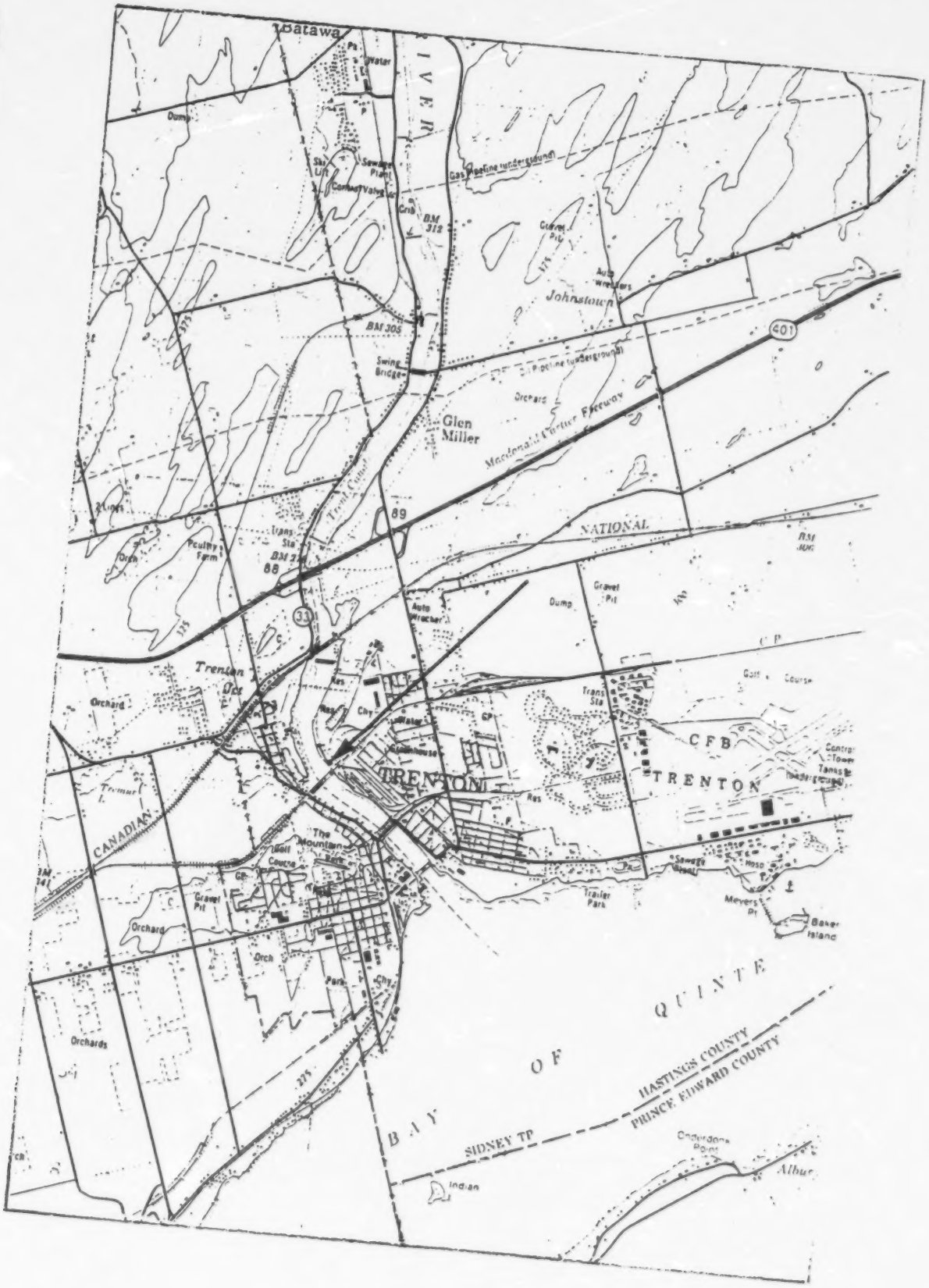
Receiving watercourse: Trent River (via Bay of Quinte to Lake Ontario)

flow: 1960 cu m/day BOD: 5300 Kg/day
SS: 593 Kg/day

One trout bioassay, performed in 1986, indicated that it would take, statistically, 37% effluent to kill 50% of the fish by the end of four days exposure. A 1983 MOE study indicated increased phenolics concentrations in the Trent River from those found in 1981. When the black liquor was misapplied as a dust suppressant by township or county workers, occasional problems have been caused in well drinking water.

Clean corrugating waste and hardwood logs and chips are made into corrugating medium. The mill consists of repulpers, wood rewashing, digesters (cleaners/washers, sodium carbonate cook) and sheet formation (cylinder machine). Mill was built to use cereal straws with milk of lime pulping. In 1951 caustic pulping was used. Mill was modernized in 1956 to use forests north of Trenton.

Domtar is providing for the installation of a black liquor evaporator. The mill has installed a new paper machine to increase production (to approximately 280 megagrams per day). An effluent diffuser was installed in 1969. During 1972-74 an aggressive water recycle program reduced effluent volume markedly. Unable to run mill with zero-discharge due to product quality considerations. In 1974 chemicals for pulping were switched to a sulphur free system.


Batawa
Johnstown
Glen Miller
Macdonald-Cartier Freeway
NATIONAL
Trenton
TRENTON
CFB TRENTON
CANADIAN
The Mountain
Orchards
BAY OF QUINTE
HASTINGS COUNTY
PRINCE EDWARD COUNTY
SIDNEY TP
Indian
Albur
401
33
89

Domtar Packaging Ltd , Trenton

Site	Type	Date	LC50	Remarks
Boiler House	grab	760613	100	
Boiler House	grab	770613	100	pH adjusted to 7.0
Boiler House	grab	770613	44	LC50 range 30-65 %
Boiler House	grab	770726	56	
Boiler House	grab	770726	100	non-lethal
Boiler House	grab	780322	28	LC50 range 20-40 %
Boiler House	grab	780502	40	
Boiler House	grab	800526	56	
Combined Sample	grab/comp	770613	47	
Combined Sample	grab/comp	770726	76	
Combined Sample	grab/comp	780322	39	LC50 range 30-50 %
Combined Sample	grab/comp	780502	25	
Combined Sample	grab/comp	800526	30	
Combined Sample	grab	811117	38	
Combined Sample	grab	811117	38	
Cooling Water	grab	760913	100	non-lethal
Cooling Water	grab	770613	100	non-lethal
Cooling Water	grab	770726	100	non-lethal
Cooling Water	grab	780322	100	non-lethal
Cooling Water	grab	780502	100	non-lethal
Cooling Water	grab	800526	100	>100 %
Digester Drains	grab	760913	100	unaerated >100 %
Digester Drains	grab	770613	100	non-lethal
Digester Drains	grab	770726	100	non-lethal
Digester Drains	grab	780322	100	non-lethal
Digester Drains	grab	780502	100	non-lethal
Digester Drains	grab	800526	100	>100 %
Economizer Effluent	grab	760913	100	non-lethal
Economizer Effluent	grab	770613	100	non-lethal
Economizer Effluent	grab	770726	100	non-lethal
Economizer Effluent	grab	780322	100	non-lethal
Economizer Effluent	grab	780502	100	non-lethal
Economizer Effluent	grab	800526	100	non-lethal
Economizer Pad Drainage	grab	760913	100	non-lethal
Economizer Pad Drainage	grab	770613	100	non-lethal
Economizer Pad Drainage	grab	780322	100	non-lethal
Economizer Zero	grab	800526	100	>100 %
Process Effluent	grab	760823	7.6	
Process Effluent	grab	760823	5.6	unaerated
Process Effluent	grab	770613	24	LC50 range 20-30 %
Process Effluent	grab	770726	33	
Process Effluent	grab	770726	28	LC50 range 20-40 %
Process Effluent	grab	780322	7.2	
Process Effluent	grab	780502	2.3	
Process Effluent	grab	800526	6	
Process Eff. & Vacuum Seals	grab	760503	17	

Site	Type	Date	LC50	Remarks
Process Eff. & Vacuum Seals	grab	760503	3.2	unaerated
Process Eff. & Vacuum Seals	grab	760913	4.2	unaerated
Process Eff. & Vacuum Seals	grab	760913	13.5	LC50 range 10-18 %
Sulphite Liquor	grab	760308	0.75	unaerated
Sulphite Liquor	grab	760308	6.6	
Vacuum Pump Seal	grab	770613	14	LC50 range 10-20 %
Vacuum Pump Seal	grab	770726	13	
Vacuum Pump Seal	grab	780327	100	non-lethal
Vacuum Pump Seal	grab	780502	52	
Vacuum Pump Seal	grab	800326	100	non-lethal at 65 %
Vacuum Pump Seals Overflow	grab	780502	24	
Vacuum Pump Seals Overflow	grab	800526	7	

Domtar Packaging, Red Rock

Domtar Packaging, Red Rock

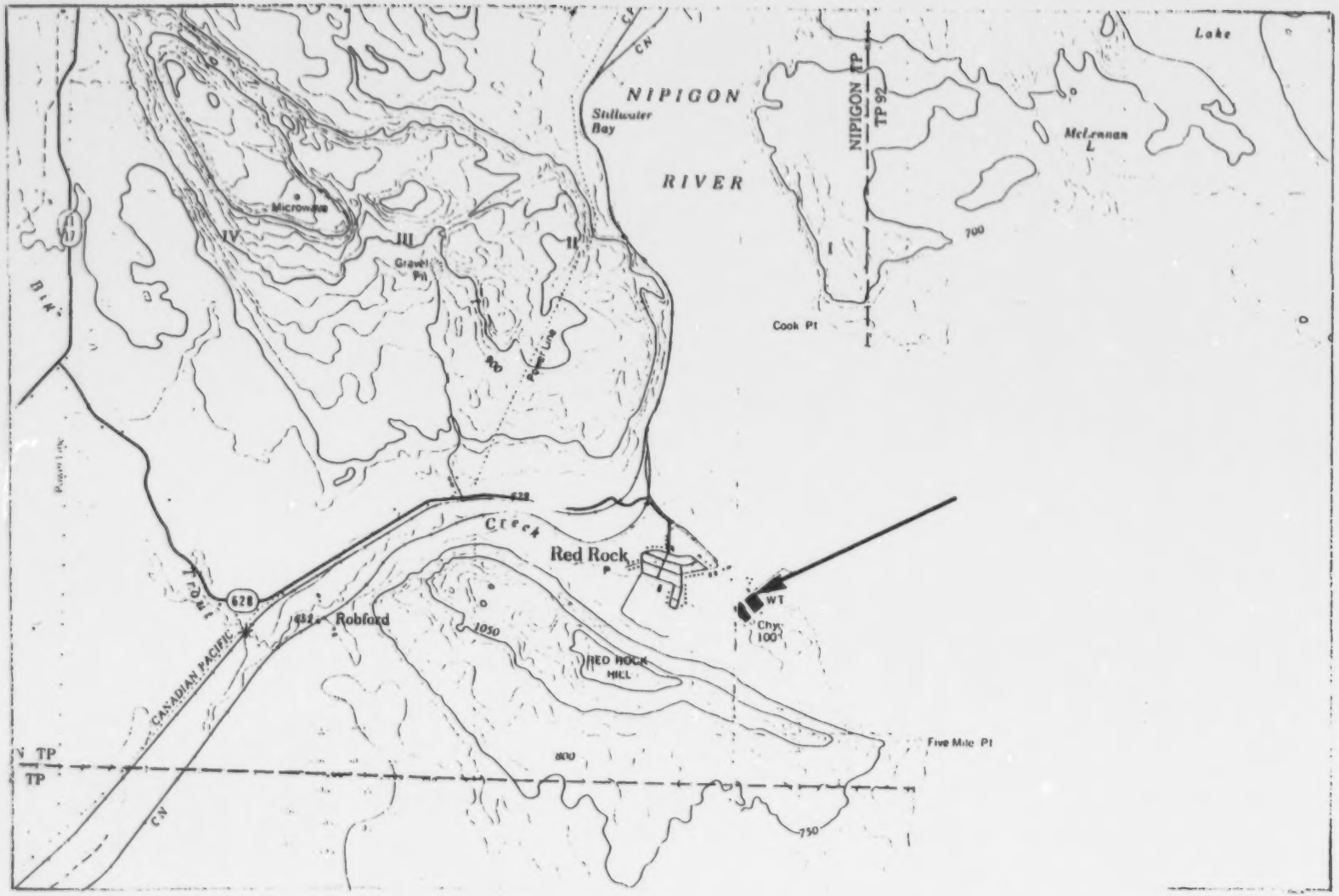
Receiving watercourse: Nipigon Bay, (Lake Superior)

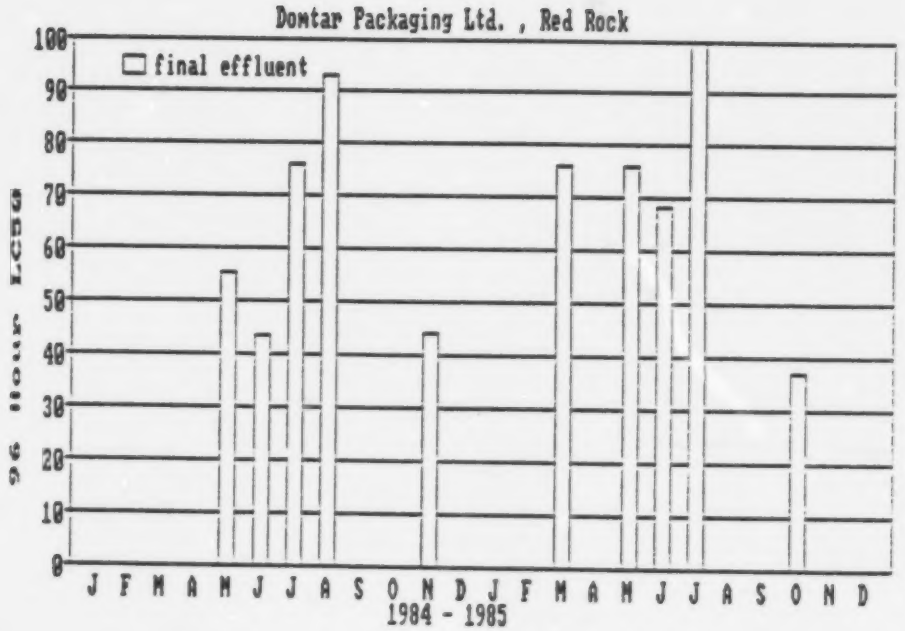
flow:	93300	cu m/day	BOD:	17800	Kg/day
PHOS:	18.3	Kg/day	DS:	49500	Kg/day
SS:	4350	Kg/day			

Nine trout bioassays, performed in 1985, indicated that it would take, statistically between 37.6% and 100% effluent to kill 50% of the fish by the end of the four days exposure. A commercial fishery existed during the period 1940-60 in Nipigon Bay. Between 1975 and 1977, extensive effluent and receiving water surveys were completed to define the impact of the effluent plume in Nipigon Bay. In 1983, a caged fish study, a plume study and a clam exposure study was carried out to help access the impact of the mill effluent in Nipigon Bay. The caged fish within the plume died.

This mill was built in 1945 as a sulphite pulping operation and was converted to kraft pulping in 1959. Domtar purchased the mill in 1961. An expansion and renovation project was undertaken in 1970 and completed in 1972. In 1973 all wood is delivered by truck, no river driven logs. Logs are wet drum debarked. Linerboard is made of softwood and some purchased hardwood chips by the kraft pulping process. Newsprint is made of softwood by the groundwood process plus 25% kraft pulp which is semi-bleached in a three-stage (CEH) bleachery process. Kraft pulping is in 10 batch digesters and one M & D continuous digester for soft (sawdust) pulp stock.

Changes made in 1982 improved effluent quality to almost non-lethal status without secondary treatment. The mill has installed conventional kraft mill abatement systems such as the segregation of cooling water, low solids (less than 50 ppm) and high solids (greater than 50 ppm) streams. The high solid waste stream is treated in the clarifier. The abatement equipment consists of a clarifier on the high suspended solids wastewaters, a a condensate stripper, in-mill spill systems, alum treatment of woodroom effluent for toxicity reduction.


NIPIGON
RIVER
Stillwater Bay
NIPIGON TP
TP 92
McLennan L
Lake
Cook Pt
Microwave
IV
III
II
I
Gravel Pit
800
700
CN
Red Rock
Creek
628
Robford
CANADIAN PACIFIC
TRANS
1050
RED ROCK HILL
WT
Chy
100
Five Mile Pt
TP
TP
800
750
CN



Domtar Packaging Ltd , Red Rock

Site	Type	Date	LC50	Remarks
clarifier effluent	2.5 hr grab comp.	800707	37	
clarifier effluent	4 hr grab	800722	34	
clarifier effluent	4hr composite	830609	61	
clarifier effluent	4hr composite	830621	100	
clarifier effluent	4hr composite	830717	73	
clarifier effluent	3hr composite	830808	65	
clarifier effluent	4hr composite	840723	100	greater than 100 %
clean water stream	grab	830610	100	greater than 100 %
clean water stream	4hr composite	830621	100	greater than 100 %
clean water stream	4hr composite	830717	100	greater than 100 %
clean water stream	3hr composite	830808	100	greater than 100 %
final effluent		750616	28	strip. not in oper.
final effluent		750624	49	unaerated
final effluent		750707	25	unaerated
final effluent		750714	22	unaerated,
final effluent	grab	770802	100	non-lethal
final effluent	grab	770913	100	greater than 100 %
final effluent	grab	770913	65	
final effluent	grab comp.	800707	22	
final effluent	4 hr grab comp.	800722	30	
final effluent	4 hr grab comp.	800730	30	
final effluent	4 hr grab comp.	800825	100	non-lethal,
final effluent	4 hr grab comp.	800825	100	
final effluent	4 hr grab comp.	801020	30	
final effluent	grab	810309	61	dilut. mill water
final effluent	grab	810309	60	

Domtar Packaging Ltd , Red Rock

Site	Type	Date	LC50	Remarks
final effluent	4 hr comp.	810812	50	split with m381113
final effluent	4 hr comp.	810812	39	
final effluent	comp.	810818	100	greater than 100 %
final effluent	3 hr comp.	810825	62	
final effluent	grab	820612	100	greater than 100 %
final effluent	grab	820612	90	
final effluent	grab	820612	70.5	
final effluent	grab	820616	70.5	
final effluent	6hr composite	821020	81.6	
final effluent	6hr composite	821118	89.8	
final effluent	grab	830211	69.8	
final effluent	grab	830211	64.5	
final effluent	grab	830304	54	
final effluent	grab	830304	28	
final effluent	4hr composite	830421	81	
final effluent	4hr composite	830421	81	
final effluent	24hr composite	830524	100	
final effluent	24hr composite	830610	6.8	
final effluent	24hr composite	830622	67	
final effluent	grab	830717	84	
final effluent	grab	830718	80	
final effluent	24hr composite	830718	100	greater than 100 %
final effluent	grab	830719	100	greater than 100 %
final effluent	grab	830720	78	
final effluent	grab	830721	90	
final effluent	24hr composite	830809	81	
final effluent	24hr composite	830810	81	
final effluent	24hr composite	830817	65	
final effluent	24hr composite	830818	85	
final effluent	24hr composite	830824	34	
final effluent	4hr composite	840509	20.2	17.0-23.9
final effluent	24Hr. composite	840511	55.1	
final effluent	4hr composite	840529	74.8	51.3-100. %
final effluent	4hr composite	840529	82.4	67.7-100 %
final effluent	4hr composite	840605	43.8	39.1-49.1
final effluent	6hr composite	840626	33.7	27.4-84.9
final effluent	5hr composite	840627	49.9	
final effluent	grab	840711	76.2	68.4-84.9
final effluent	4hr composite	840723	100	greater than 100 %
final effluent	4hr composite	840724	84.2	
final effluent	24hr composite	840822	100	greater than 100 %
final effluent	24hr composite	840822	100	greater than 100 %
final effluent	24 hr. composite	840823	80.6	40.ppm water dilu.
final effluent	24hr composite	840823	100	greater than 100 %
final effluent	24hr composite	840823	93.1	
final effluent	24 hr. composite	840823	76	hard water dilution
final effluent	24 hr composite	840824	80.6	40.ppm water dilu.
final effluent	24hr composite	840824	80.6	hard water dilution
final effluent	24 hr. composite	841108	44.3	
final effluent	24hr composite	850324	76	
final effluent	24hr composite	850507	76.2	
final effluent	24hr composite	850523	80.6	
final effluent	24hr composite	850603	68	
final effluent	24hr composite	850715	80.6	
final effluent	24hr composite	850715	100	>100
final effluent	24hr composite	850718	100	>100
final effluent	24hr composite	851007	37.6	31.2-45.3
final effluent	24hr composite	851009	68.3	

Domtar Packaging Ltd , Red Rock

Site	Type	Date	LC50	Remarks
intake water	grab	830717	100	non-lethal
intake water	grab	830718	100	non-lethal
intake water	grab	830719	100	non-lethal
intake water	grab	830720	100	non-lethal
intake water	grab	830721	100	non-lethal
Low suspended solid stream	2.5 hr grab comp.	800707	30	
Low suspended solid stream	4 hr grab comp.	800722	30	
Low suspended solid stream	4hr composite	830609	31	
Low suspended solid stream	4hr composite	830621	65	
Low suspended solid stream	4hr composite	830717	50	
Low suspended solid stream	3hr composite	830809	54	
Low suspended solid stream	4hr composite	840723	53.2	43.1-65.6 %
Uncontaminated stream	2.5 hr grab comp.	800707	100	non-lethal
Uncontaminated stream	4 hr grab comp.	800722	70	
woodroom, after alum	4hr composite	830609	2.2	pH adj. to 6.5
woodroom, after alum	4hr composite	830609	6.1	
woodroom, after alum	24hr composite	830718	1.6	
woodroom, after alum	3hr composite	830809	7	
woodroom, after alum	grab	830822	2.2	
woodroom, after alum	grab	830822	2.2	
woodroom, after alum	grab	830822	13	pH adj. to 7.0
woodroom, after alum	4hr composite	840723	10	less than 10 %
woodroom, before alum	grab	830822	7	

E. B. Eddy Forest Products, Espanola

E. B. Eddy Forest Products Ltd., Espanola

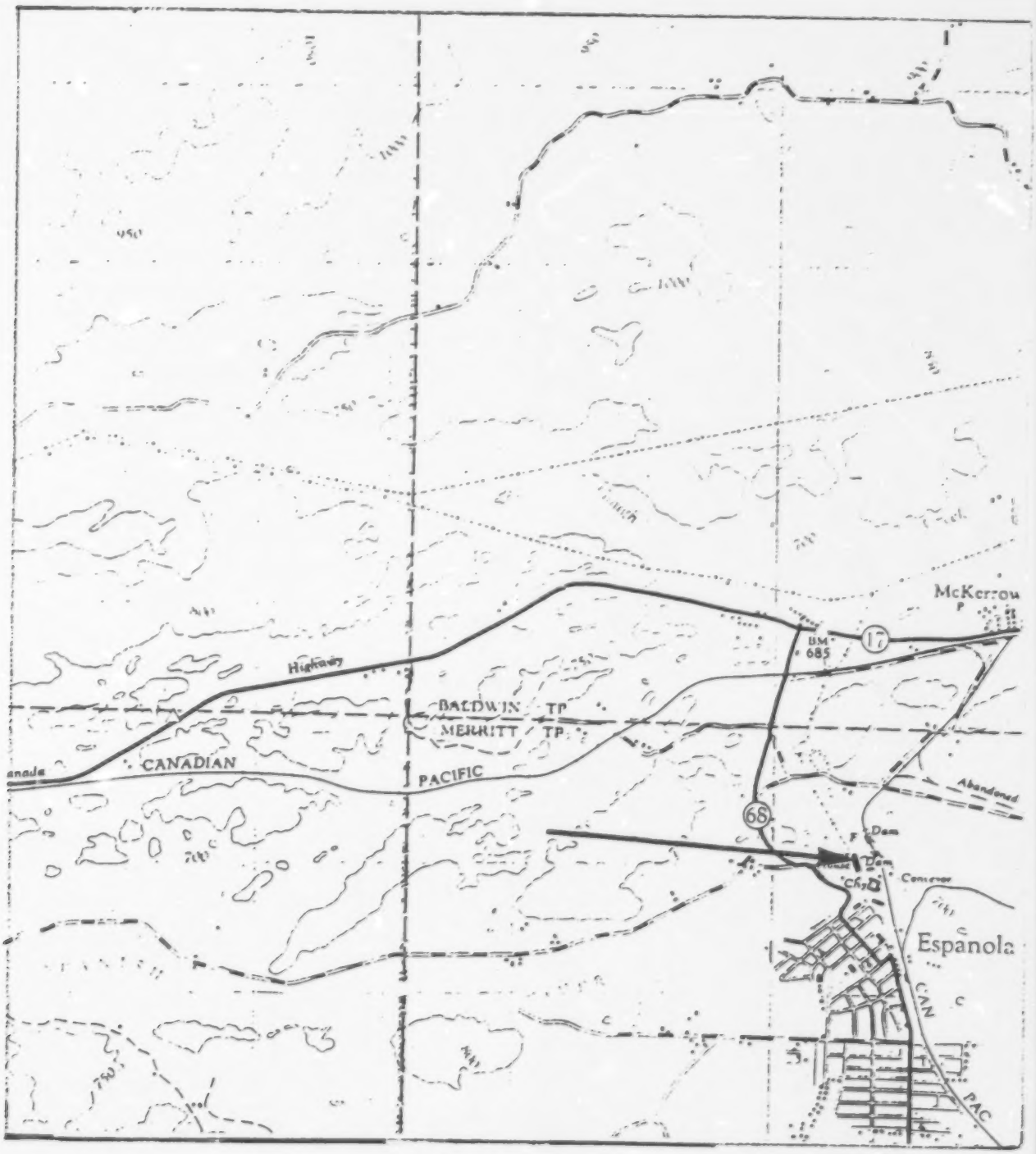
Receiving watercourse: Spanish River. (Lake Huron)

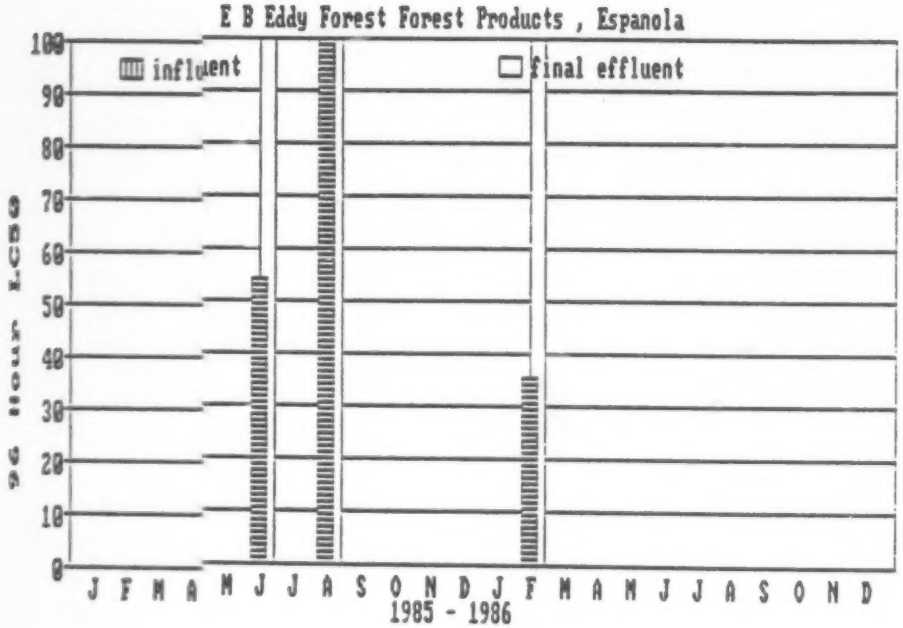
flow: 100325 cu m/day BOD: 2690 Kg/day
SS: 5284 Kg/day pH: 6.9-7.4

The treated (aerated stabilization basin) final discharge does not normally kill fish. Two toxicity tests done in 1985 found the final effluent to have been non-lethal to test fish. Low flow conditions in the Spanish River can be aggravated by the storage of water for power generation by INCO upstream of the mill and by the mill itself. This may result in the oxygen content falling below 47% saturation downstream of the mill and cause the fish to suffocate. There has not been a low flow condition in recent years and a flow management committee of E. B. Eddy, Inco, MNR and MOE has led to improved flow management. Since 1947, air and water pollution problems with kraft pulping were documented by various Ontario government agencies. Recreational and tourist use of the surrounding area have focussed attention on the Spanish River. The Spanish River has been subjected to oxygen depletion, pH fluctuations and aesthetic impairment. Biological communities have been affected including fish tainting complaints in the Spanish Harbour. A 1980 river study identified a serious dissolved oxygen problem during low flow conditions. Fish kills have been documented in 1982 and 1983. The mill modernization, including a low odour recovery furnace, Non Condensible Gas (odour) incinerator system and a new lime kiln-reduce odours but there appears to be little discernable difference in the immediate vicinity of the mill.

Started operation as a groundwood pulp mill. The mill ceased operations between 1936 and 1946. A 180 megagrams per day kraft mill was put on stream in 1946. Since the end of 1983, the modernized mill can produce in excess of 820 megagrams/day of product. The groundwood process was shutdown in 1966. Hardwood and softwood logs and chips are made into bleached pulp and specialty paper. (The mill consists of wet drum debarking, digesters/cleaners/washers (old and new), bleaching, pulp formation (old and new) and specialty papermaking.

Since 1970, the mill has been undergoing an internal rebuild; the mill has been kept operating while construction went on. For instance, the wood ashes were taken out of sewer; a bark fine recovery system was installed; fibre recovery was put in the pulp washing, paper machine and bleachery areas, etc. A paper mill clarifier was installed to remove pulp fibre. This mill is the only Canadian operator of oxygen bleaching. This design reduces the raw discharge of Biochemical Oxygen Demand and effluent colour. An aerated stabilization basin was put on stream September 1983 to treat all mill wastewaters prior to discharge to the Spanish River. Significant improvement was measured in the river.


McKerrow
BM 685
17
Highway
BALDWIN TP
MERRITT TP
CANADIAN
PACIFIC
Abandoned
68
Dam
Espanola
CAN
PAC



E.B.Eddy Forest Products Ltd , Espanola

SITE	TYPE	DATE	LC50	REMARKS
bleach chlorination stage	grab	820827	62.1	
bleach chlorination stage	grab	820827	6.2	
bleach chlorination stage	grab	820827	55	
bleach chlorination stage	grab	820827	5.2	
Final Effluent	grab	760531	24	18-32 % - unaerated
Final Effluent	grab	760531	7.5	5.6-10 % - unaerated
Final Effluent	grab	770307	19	
Final Effluent	grab	770330	84.3	
Final Effluent	grab	770511	35.4	
Final Effluent	grab	770530	14	unaerated 10-20 %
Final Effluent	grab	770530	65	65 % LT100 12 hrs
Final Effluent	grab	770621	17	
Final Effluent	grab	770808	10	
Final Effluent	grab	770823	12	
Final Effluent	grab	770913	23	
Final Effluent	grab	780424	45	
Final Effluent	grab	780424	44	LC50 range 30-65 %
Final Effluent	grab	780424	12	unaerated
Final Effluent	grab	790730	60	
Final Effluent	grab	800729	100	only hardwood opera.
Final Effluent	grab	800826	35	
Final Effluent	grab	811110	35	
Final Effluent	grab	850624	100	>100
Final Effluent	24hr composite	850819	100	>100
influent	grab	850624	54.1	
influent	24hr composite	850819	100	>100

E.B.Eddy Forest Products Ltd , Espanola

SITE	TYPE	DATE	LC50	REMARKS
Intake	grab	770307	100	non-lethal
Intake	grab	770330	100	non-lethal
Intake	grab	770511	100	non-lethal
Intake	grab	770530	100	non-lethal
Intake	grab	770530	100	non-lethal
Intake	grab	770621	100	non-lethal
Intake	grab	770809	100	non-lethal
Intake	grab	770823	100	non-lethal
Intake	grab	770913	100	non-lethal at 72 hrs
Intake	grab	780424	100	non-lethal
Intake	grab	780424	100	non-lethal - unaerated
Intake	grab	790730	100	non-lethal
Intake	grab	800729	100	non-lethal
Intake	grab	800826	100	non-lethal
Intake	grab	811110	100	non-lethal
Intake	grab	811110	100	non-lethal
kraft sewer	grab	790730	42	range 32-56 %
kraft sewer	grab	820827	27.7	
lime kiln scrubber sump	grab	820827	100	non-lethal
main sewer before lagoon	grab	790730	42	range 32.-56 %
main sewer before lagoon	24hr composite	820827	19.6	
main sewer before lagoon	24hr composite	820827	31.1	
No.1 Bleach Plant	grab	770307	13	
No.1 Bleach Plant	grab	770330	14	LC50 range 10-20 %
No.1 Bleach Plant	grab	770511	14	LC50 range 10-20 %
No.1 Bleach Plant	grab	770530	10	unaer. 10 % LT100 4 hr
No.1 Bleach Plant	grab	770530	65	65 % LT100 30 min.
No.1 Bleach Plant	grab	770621	14	LC50 range 10-20 %
No.1 Bleach Plant	grab	770808	100	non-lethal at 10 %
No.1 Bleach Plant	grab	770823	7.1	LC50 range 5-10 %
No.1 Bleach Plant	grab	770913	100	non-lethal
No.1 Bleach Plant	grab	780424	24	LC50 range 20-30 %
No.1 Bleach Plant	grab	780424	37	pH adjusted
No.1 Bleach Plant	grab	790730	28	pH adjusted to 6.3
No.1 Bleach Plant	grab	790730	13	LC50 range 10-28 %
No.2 Bleach Plant	grab	770307	8.2	
No.2 Bleach Plant	grab	770330	14	LC50 range 10-20 %
No.2 Bleach Plant	grab	770511	23.7	
No.2 Bleach Plant	grab	770530	10	unaer. 10% LT100 3 hr
No.2 Bleach Plant	grab	770530	65	65 % LT100 30 min
No.2 Bleach Plant	grab	770621	2	2% LT100 4 hrs
No.2 Bleach Plant	grab	770808	100	non-lethal at 10 %
No.2 Bleach Plant	grab	770823	7.1	LC50 range 5-10 %
No.2 Bleach Plant	grab	770913	100	non-lethal
No.2 Bleach Plant	grab	780424	30	pH adj.to 7.7-
No.2 Bleach Plant	grab	780424	10	pH adj.to 7.7-
No.2 Bleach Plant	grab	780424	4.7	unaerated
No.2 Bleach Plant	grab	780424	14	LC50 range 10-20 %
No.2 Bleach Plant	grab	790730	37.5	
paper clarifier	grab	820827	100	non-lethal
parchment sewer	grab	820827	100	non-lethal

E.B.Eddy Forest Products Ltd , Espanola

SITE	TYPE	DATE	LC50	REMARKS
wood room	grab	760531	12	unaerated
wood room	grab	780424	11	
wood room	grab	790730	10	<10% pH adjusted to 7.
wood room	grab	790730	4.2	
wood room	grab	800729	4	
wood room	grab	800729	2.2	stored 1 week
wood room	grab	800729	5.8	treated
wood room	grab	811110	6.7	
wood room	grab	820827	4.1	

E. B. Eddy Forest Products Limited, Ottawa

E. B. Eddy Forest Products Limited, Ottawa

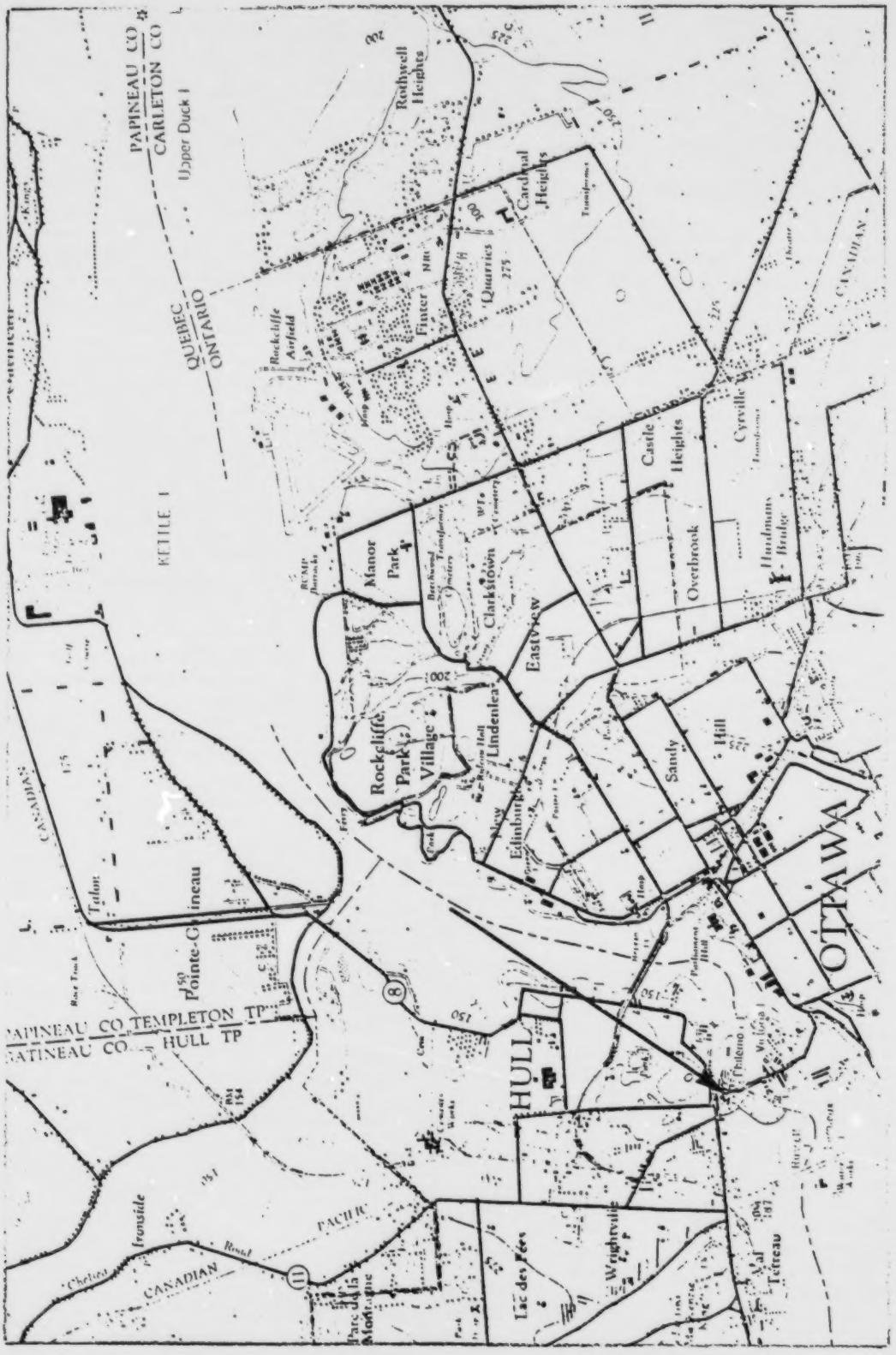
Receiving watercourse: Ottawa River

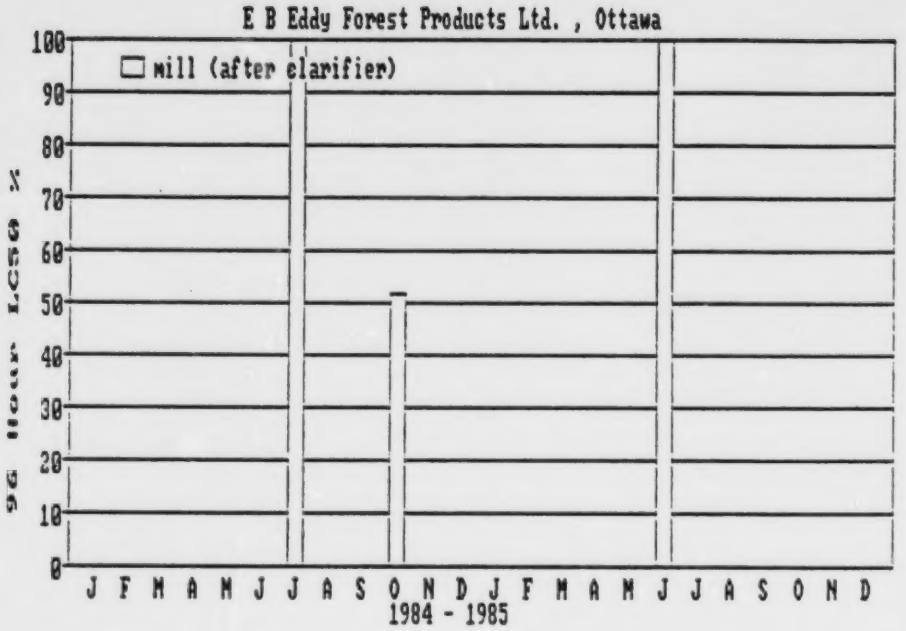
flow: 7320 cu m/day BOD: 1018 Kg/day
SS: 590 Kg/day

The effluent from the mill does not normally kill fish. A bioassay conducted in 1985, determined the effluent to have been non-acutely lethal to test fish. The discharge of coloured, material and suspended solids has contributed to the aesthetic impairment of the Ottawa River. Although the pollution load of this effluent is small, the effluent visibility problem was ameliorated in the summer of 1984 by installing deeper diffusers. The National Capital Commission has proposed in the past to buy the property and convert it into a park.

The mill converts pulp and paper for writing and printing. It has had problems with its competitive position despite upgrading of the small and outmoded paper machines. The paperboard mill was closed in September 1979, due to lack of viability. To a great extent, this mill is integrated with Eddy's paper mill in Hull.

Conventional effluent treatment (fibre recovery, whitewater recycle systems, automated savealls, primary clarifier, diffuser) equipment was installed after several paper machine modifications were made to recycle white waters, etc. Clarifier installed in 1978. Clean and dirty waters separated in 1981; dirty wastewaters only to clarifier. Sanitary wastes were segregated in 1981 and are treated by E. B. Eddy.


PAPINEAU CO
CARLETON CO
QUEBEC
ONTARIO
Upper Duck I
Rockcliffe Airfield
Rothwell Heights
Cardinal Heights
Quarries
Manor Park
Clarkstown
Eastview
Castle Heights
Overbrook
Cyrville
Rockcliffe Park Village
Lindenlea
New Edinburgh
Sandy Hill
OTTAWA
HULL
Talon
Pointe-Gatineau
PAPINEAU CO TEMPLETON TP
GATINEAU CO HULL TP
Ironside
CANADIAN
Wrightville
Lac des Fées
Tetreau



E.B.Eddy Forest Products Ltd , Ottawa

Site	Type	Date	LC50	Remarks
Board mill sewer	grab	770720	80	LC50 range 65-100 %
Board mill sewer	grab	770804	100	non-lethal
Board mill sewer	composite	770804	100	non-lethal
Board mill sewer	grab	770804	90	LC50 range 80-100 %
Board mill sewer	grab	770804	100	non-lethal
Board mill sewer	grab	770804	100	non-lethal
Board mill sewer	grab	770907	100	non-lethal
Mill (after clarifier)	grab	770720	65	
Mill (after clarifier)	composite	770804	100	non-lethal
Mill (after clarifier)	grab	770804	100	non-lethal
Mill (after clarifier)	grab	770804	100	non-lethal
Mill (after clarifier)	grab	770804	100	non lethal
Mill (after clarifier)	grab	770804	100	non-lethal
Mill (after clarifier)	grab	770907	100	
Mill (after clarifier)	grab	801014	86	clarifier by passed
Mill (after clarifier)	grab	821110	50.8	
Mill (after clarifier)	grab	821110	25.5	
Mill (after clarifier)	grab	831128	51	
Mill (after clarifier)	grab	840726	100	non-lethal
Mill (after clarifier)	grab	841026	51.9	
Mill (after clarifier)	grab	850627	100	>100
Specialty mill(pre clarifie	grab	770720	50	less than 50 %
Specialty mill(pre clarifie	grab	770804	100	non-lethal
Specialty mill(pre clarifie	grab	770804	100	non-lethal
Specialty mill(pre clarifie	grab	770804	90	
Specialty mill(pre clarifie	grab	770804	100	non-lethal
Specialty mill(pre clarifie	grab	770907	100	non-lethal

Fraser Inc., Thorold

Fraser Inc., Thorold

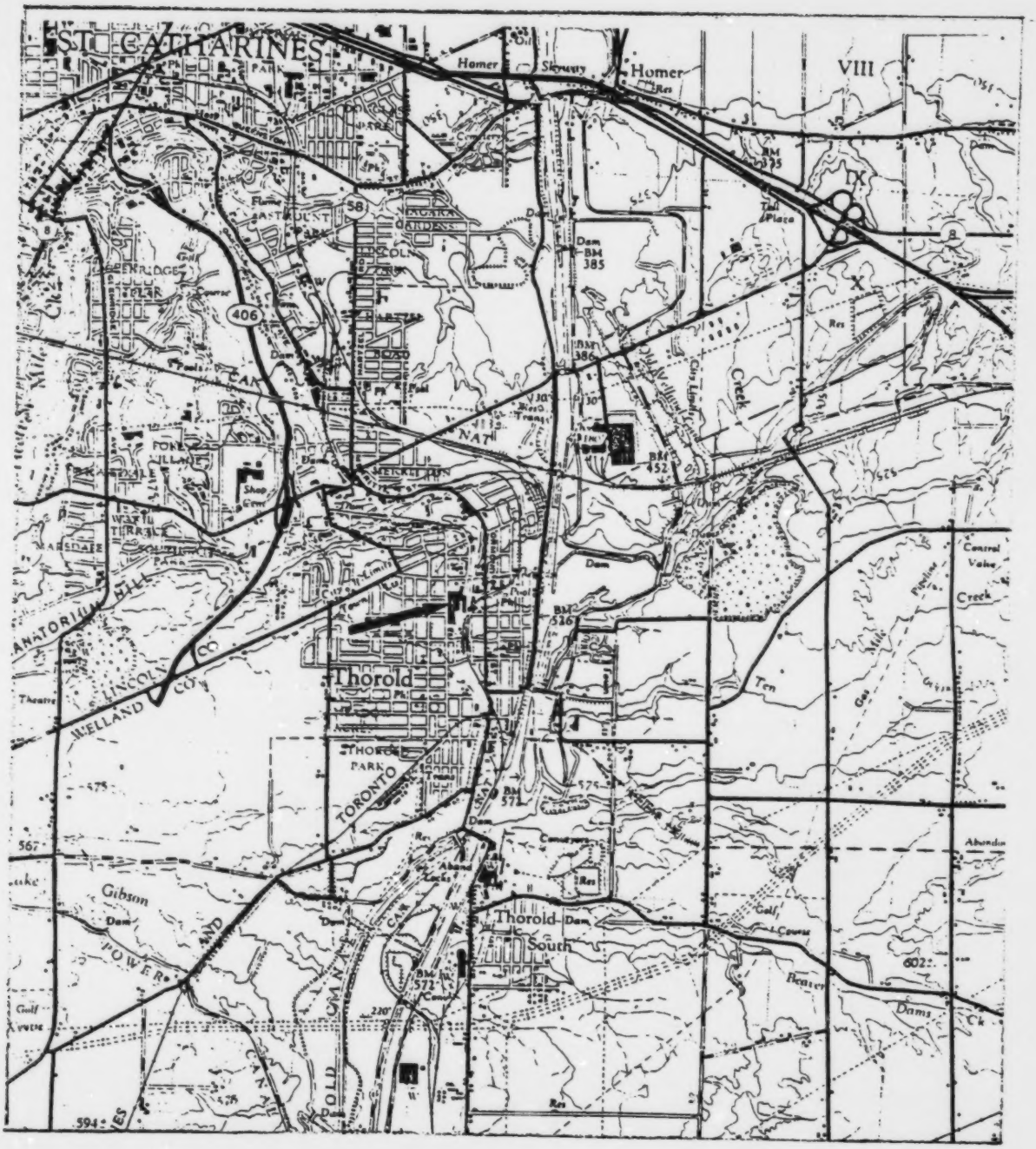
Receiving watercourse: Old (second) Welland Canal
then to Twelve Mile Creek and Lake Ontario.

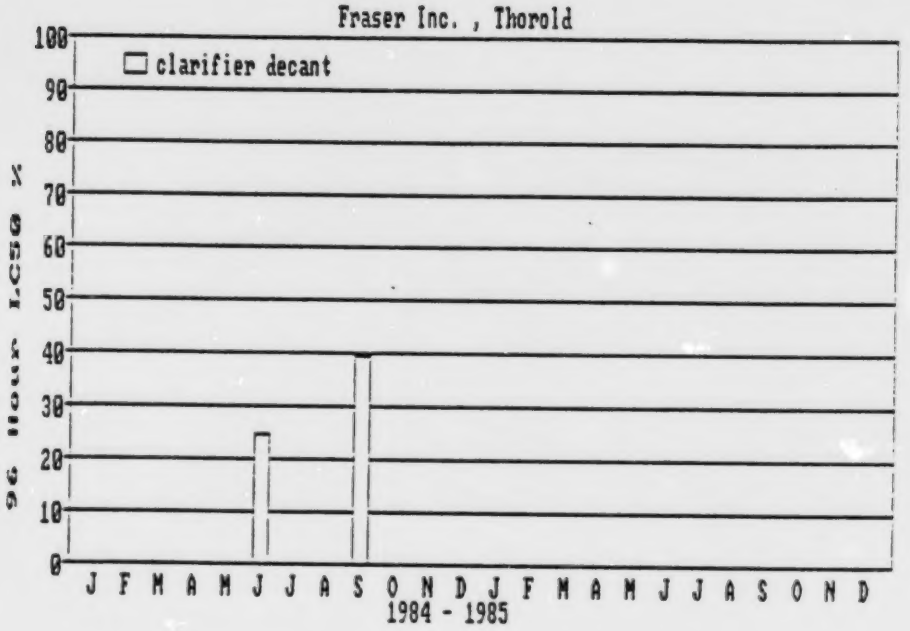
flow:	24800	cu m/day	BOD:	2091	Kg/day
DS:	7190	Kg/day	SS:	1014	Kg/day

The effluent is toxic to fish. Two trout bioassays, performed in 1984, indicated that it would take, statistically, 25%, and 39% effluent to kill 50% of the fish by the end of four days exposure. Effluent needs to be investigated for trace organics. High bacteria counts of Klebsiella pneumoniae and Pseudomonous aeruginosa are found in the Old Welland Canal. Sources have been identified by West Central Region staff in the 1984 survey. The aesthetic problem, associated with the paper mills' discharges, of the Old Welland Canal is highly visible due to the development of recreational trails along the canal route.

Part of the mill dates to 1902. The latest addition to the mill, a paper machine was completed in 1961. The mill was owned by Abitibi-Price until 1981. The drinking process was started in 1946 and is the only mill to deink ledger paper. Fine printing and writing papers are made from purchased pulp and deinked fine papers. This is the only used fine paper deinking mill in Canada which occasionally imports used ledger paper from as far as Florida, U.S.A.

Compliance was achieved through the construction and implementation in 1981 of a modern conventional activated sludge system with neutralization, clarification, aeration and secondary settling. The original circular clarifier was integrated into the design. The treatment system was designed as a stacked package to minimize the use of land. The control of odour and foam from the activated sludge plant is critical to prevent complaints. Water sprays were installed to control airborne foam from the activated sludge plant. Clarifier may have to be by-passed due to a high clarifier torque or a failure of the mill pumping system. The mill has been attempting to recycle clarified effluent; this reached about 8% of the raw water but is presently suspended. A second clarifier may be required to ensure TSS control during scheduled clarifier maintenance and emergencies. A clarifier was installed in 1968 and subsequently fibre recycle and reuse systems have been installed at the paper machines. An innovative effluent treatment system was installed in 1981 for secondary treatment of deinking wastewaters; this activated sludge system treats deinking effluent. The clarifier treats the total mill effluent. Sanitary wastes are separated and discharged to the municipal sewer system.


ST. CATHARINES
Homer
Skyway
Homer
VIII
IX
X
406
Thorold
Thorold South
Gibson
Dam
Creek
Welland Canal
Toronto
Lincoln Co
Welland Co
Power
Canal
Dams
Ck



Fraser Inc , Thorold

Site	Type	Date	LC50	Remarks
clarifier decant	grab	770228	39	
clarifier decant	grab	770228	50	dechlorinated
clarifier decant	grab	800423	37	
clarifier decant	grab	811201	100	non-lethal
clarifier decant	grab	840625	24.7	
clarifier decant	grab	840919	39.2	chlorine odour

Great Lakes Forest Products Ltd., Dryden

Great Lakes Forest Products Ltd., Dryden

Receiving watercourse: Wabigoon River (English River/Arctic)

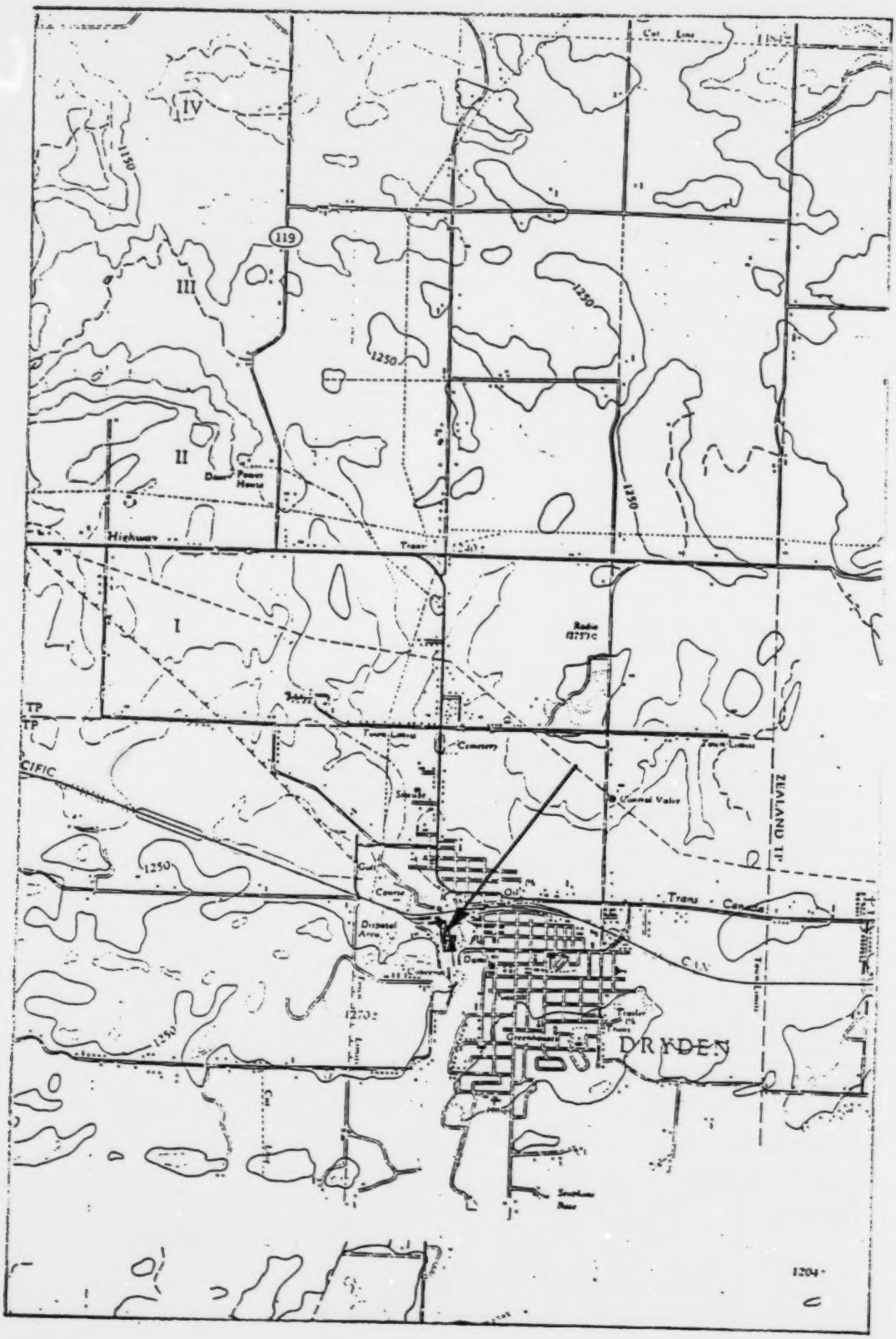
flow: 79400 cu m/day BOD: 2830 Kg/day
SS: 5049 Kg/day

There have been periods in 1984 and 1985 when the mill discharge was of low toxicity but most of the time it has been toxic to fish. Five trout bioassays conducted in 1985, indicated that, statistically, the percentage effluent required to kill 50% of the fish by the end of the four days exposure ranged from 13.4% to >100% (non-lethal). The mill has been the centre of environmental controversy over the discharge of mercury from the associated chlor-alkali plant of Dryden Chemicals. This plant successfully met the MOE requirements following a "clean up and treat" Directive, and subsequently, on the initiative of Reed Ltd., in 1975 replaced the mercury-cell chlor-alkali process with new non-mercury technology using permionic membrane cells - the first installation of its kind in North America - at a cost of $5.5 million. The gross pollution of the Wabigoon River has affected 27 miles of river and the downstream use of the river for commercial and sport fisheries. Sludge and biota mercury levels in the Wabigoon are still elevated even though discharges are minimal. Water quality may be further affected by decomposing sludge banks which were deposited in the Wabigoon before the clarifier was installed. Mercury pollution in the river system has been studied by a Federal-Provincial Committee. Blowing foam and odour problems from secondary lagoons are under evaluation and control.

The Company, originally Dryden Timber and Power Company, was formed in 1910. Production of kraft pulp and sheathing began in 1913. It was purchased in December, 1979, by Great Lakes Forest Products, Ltd. who completed a major modernization and expansion program which included several large pollution abatement measures. This mill was committed to a future in fine papers when a new paper machine was installed in 1982-83. A second large fine paper machine is scheduled for construction and start-up in the immediate future. Softwood logs and chips are made into fine papers and market bleached kraft pulp. Chips are from a company stud mill. Mill consists of dry debarking, wood rewashing, kraft pulping, kraft bleaching, kraft pulp formation and fine paper multi-product making.

Great Lakes uses continuous processes as compared to batch; this results in less spills. The following systems are used to control effluent quality:

- spill controls, clarifier on total effluent with spill pond and aeration-stabilization basins (after August, 1983),
- dry debarking,
- continuous Kamyr digester; diffusion washing; 5-stage bleach plant and a pulp dryer. The clarifier treats the total mill effluent.
- secondary treatment began in August 1983.


IV
III
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119
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Disposal Area
DRYDEN
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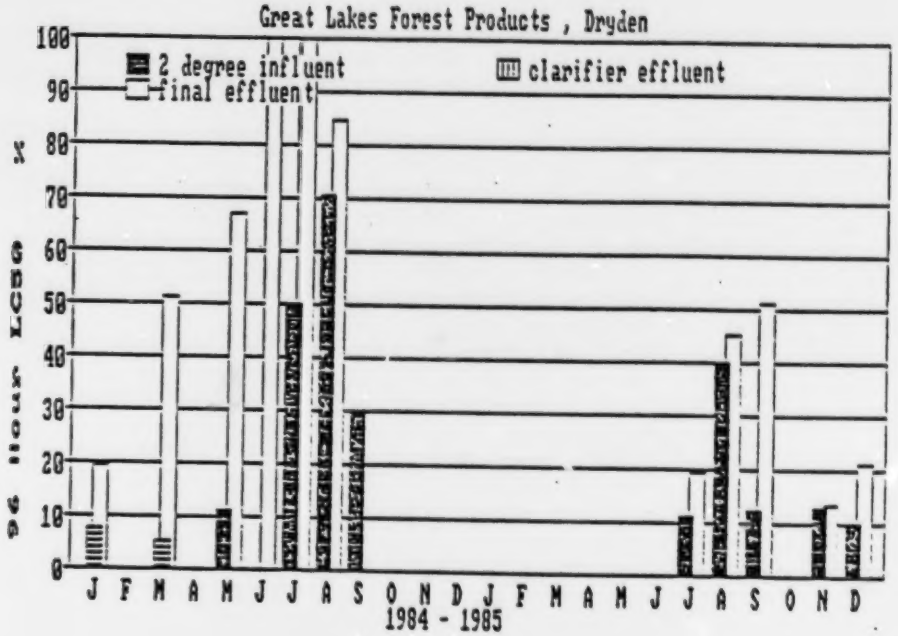
CIFIC
TP
TP



Great Lakes Forest Products , Dryden

SITE	TYPE	DATE	LC50	REMARKS
2 degree influent	4hr composite	840524	11	
2 degree influent	4hr composite	840717	50.2	39.9-63.3
2 degree influent	4hr composite	840717	53.2	43.1-65.6
2 degree influent	4hr composite	840731	37.8	32.7-43.8
2 degree influent	4hr composite	840814	70.7	63.4-78.8 %
2 degree influent	4hr composite	840814	77.3	
2 degree influent	4hr composite	840829	29.5	24.2-36.0
2 degree influent	grab	850617	11	
2 degree influent	grab	850715	40.1	
2 degree influent	grab	850806	12.5	
2 degree influent	24hr composite	851121	12.7	
clarifier effluent	1hr composite	830530	40	100% mortality at 65%
clarifier effluent	4hr composite	830726	2.2	100% mortality at 65%
clarifier effluent	2hr composite	830830	24	100% mortality at 65%
clarifier effluent	4Hr. composite	840125	7.8	
clarifier effluent	grab	840307	5.2	
clarifier influent	1hr composite	830530	12	
clean water	24hr composite	830815	100	non-lethal
clean water	24hr composite	830628	100	non-lethal
clean water	24hr composite	830815	100	non-lethal
final effluent	grab	770804	21	
final effluent	grab	800728	1.3	
final effluent	grab	800812	24	
final effluent	grab	800819	28	
final effluent	grab	810616	29	
final effluent	grab	810714	8	
final effluent	grab	810818	14	

Great Lakes Forest Products , Dryden

SITE	TYPE	DATE	LC50	REMARKS
final effluent	24hr composite	830615	84	60% mortality at 65%
final effluent	24hr composite	830628	45	100% mortality at 45%
final effluent	24hr composite	830805	40	100% mortality at 45%
final effluent	24hr composite	830815	28	100% mortality at 45%
final effluent	4Hr. composite	840125	19.6	
final effluent	grab	840307	51	
final effluent	4hr composite	840524	66.8	57.8-77.1
final effluent	4hr composite	840606	100	greater than 100 %
final effluent	4hr composite	840606	100	greater than 100 %
final effluent		840608	100	
final effluent	4hr composite	840717	100	greater than 100 %
final effluent	4hr composite	840731	100	greater than 100 %
final effluent	4hr composite	840814	100	greater than 100 %
final effluent	4hr composite	840829	90.8	
final effluent	4hr composite	840829	84.7	
final effluent		840830	62.2	40 ppm dilution water
final effluent	grab	850617	19.3	
final effluent	grab	850715	45.3	
final effluent	grab	850806	51.1	
final effluent	24hr composite	850807	100	hard dilution water
final effluent	24hr composite	850807	82	50 ppm dilution water
final effluent	24hr composite	851121	13.4	
mill effluent	24hr composite	830615	34	100% mortality at 65%
mill effluent	24hr composite	830628	20	70% mortality at 20%
mill effluent	24hr composite	830815	17	100% mortality at 65%

Great Lakes Forest Products, Thunder Bay

Great Lakes Forest Products Limited, Thunder Bay

Receiving watercourse: Kaministiquia River Lake Superior

flow:	217000	cu m/day	BOD:	46300	Kg/day
PHOS:	166	Kg/day	SS:	13300	Kg/day

The mill effluent is toxic to fish. Eight trout bioassays performed in 1985, indicated the statistical estimate of the percentage effluent required to kill 50% of the fish by the end of the four days exposure ranged from 31% to 45.6%. The dissolved oxygen problem in the Kaministiquia River requires further study and evaluation. Research is needed on the fate of chlorinated organics in the receiving waters.

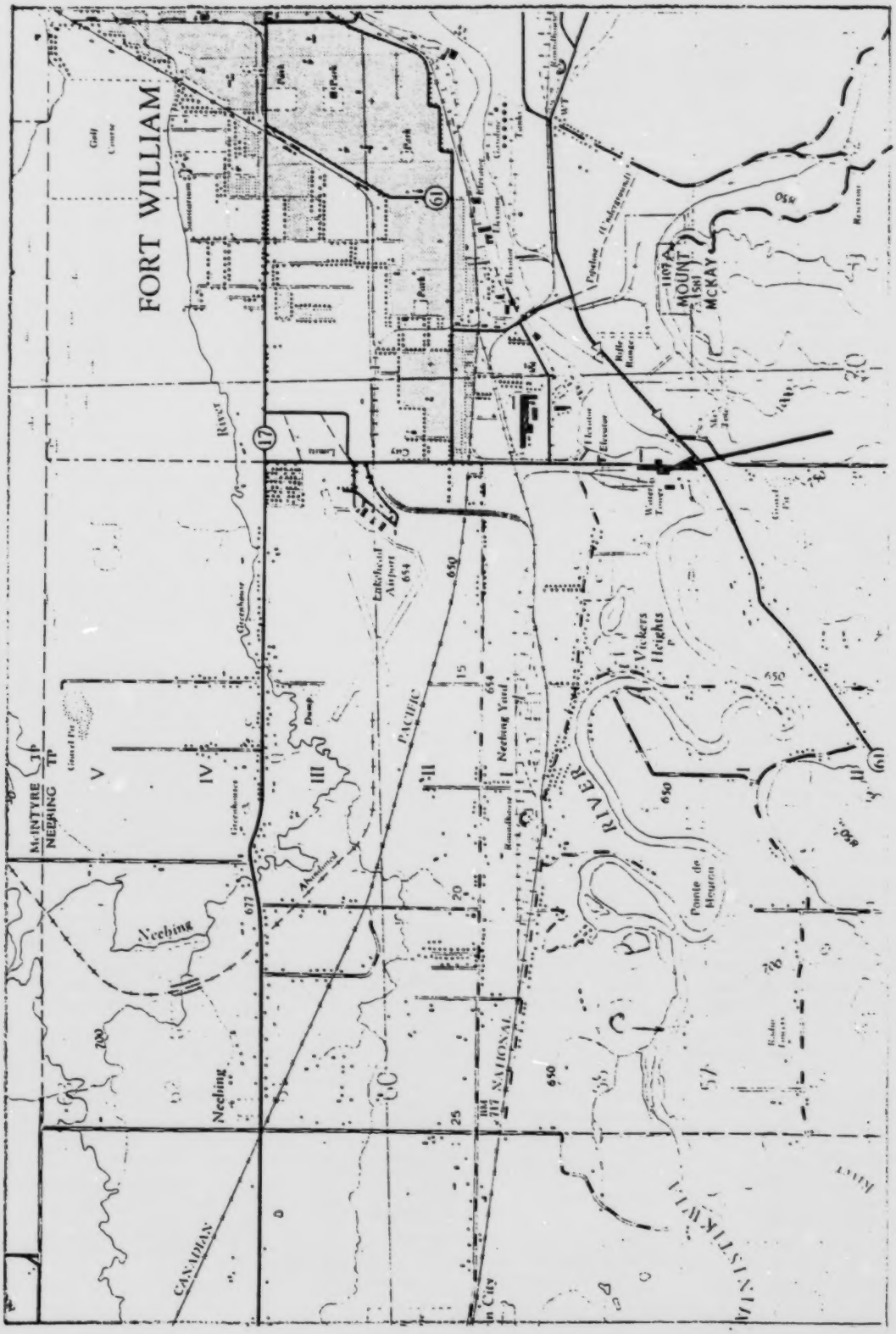
Softwood and hardwood logs are made into newsprint, bleached kraft market pulp, stud lumber and waferboard. The mill processes include: dry debarking, wood rewashing, stone groundwood pulping and brightening, high-yield bishulphite pulping (at pH 4.5), kraft pulping and bleaching with pulp sheet formation (2 kraft mills) and papermaking.

The mill complex has been the scene of several major innovations. Black liquor oxidation was introduced to reduce kraft odours in 1966. A later decision to attempt closed cycle processing for the "B" kraft mill to avoid the Ministry requirement for aerated lagoons received overwhelming public approval. The only sulphite mill in North America where spent liquor is sent to a kraft recovery furnace. Other innovations pertaining to the environmental controls include:

1971 - first application of a Copeland fluidized-bed reactor to incinerating solid wastes (which it achieves without producing significant air pollution).
1972 - first North American installation of a Swedish-developed fully-mechanized wood-handling and wood-processing system, including dry debarking.
1983 - first North American installation of a new type of pulp washer (a pressure diffuser), in "A" kraft mill.

Conventional air and water abatement equipment are combined with innovative process changes for environmental benefit such as primary effluent treatment for kraft mill "A" (1967), primary treatment for newsprint operation (1971) Rapson-Reeve (modified) closed-cycle process developed (1976-78), with salt recovery, dry barking woodroom, counter current bleach plant washing and high yield sulphite pulping (implemented 1972-1974). The spill control system is integral to the closed-cycle design.

The Mill began operation in 1924 as a groundwood mill. It began building its newsprint mill in 1927. It modernized in 1946-48 with 2 paper machines and again in 1955-58 with two more mills. In 1963, the existing sulphite mill was converted from a calcium base cooking liquor to a magnesium base. In 1966, new bleached sulphate plant commenced operation.


FORT WILLIAM
MOUNT MCKAY
McINTYRE
NEEBING
Neebing
Neebing Yard
PACIFIC
CANADIAN
NATIONAL
Vickers Heights
Pointe de Meuron
Entrance Airport
Golf Course
Park
Dump
Cemetery
Water Tower
Elevator
Rifle Range
Ski Trail
Radio Towers
Reservoir
Gasometer
Tanks
Aberdeen
Broadway
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Sanatorium
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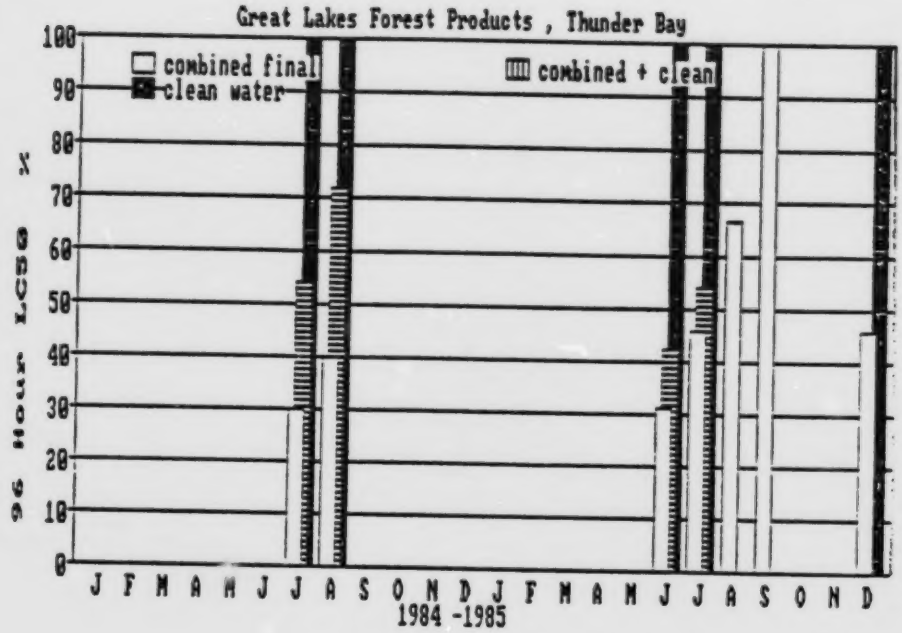
650
654
677
700
1181



Great Lakes Forest Products , Thunder Bay

SITE	TYPE	DATE	LC50	REMARKS
blender clarifier		860304	22.6	20.3-25.3
clean water effluent	24 hr comp.	800715	100	non-lethal
clean water effluent	24 hr comp.	800729	100	non-lethal
clean water effluent	24 hr comp.	800805	100	non-lethal
clean water effluent	comp.	810805	49	
clean water effluent	comp.	810811	100	non-lethal
clean water effluent	comp.	810818	100	38 % dead in 100 % conc.
clean water effluent	24hr composite	840709	100	greater than 100 %
clean water effluent	24hr composite	840807	100	greater than 100 %
clean water effluent	24hr composite	850605	100	>100
clean water effluent	grab	850710	100	>100
clean water effluent		860304	100	non-lethal
combined final	grab	770725	39	LC50 range 30-50 %
combined final	24 hr comp.	800715	33	
combined final	24 hr comp.	800729	30	
combined final	24 hr comp.	800805	20	
combined final	comp.	810805	16	
combined final	comp	810811	49	
combined final	comp.	810818	38	
combined final	24hr composite	840709	30.1	25.3-35.9
combined final	24hr composite	840807	40	35.9-44.5
combined final	24hr composite	840809	50.9	
combined final	24hr composite	850605	31	
combined final	grab	850710	45.6	
combined final	24hr composite	850812	40.1	
combined final	24hr composite	850812	42.8	
combined final	24hr composite	850813	42.8	
combined final	24hr composite	850814	45.6	
combined final	24hr composite	850815	45.6	
combined final	24hr composite	850815	40.1	

Great Lakes Forest Products , Thunder Bay

SITE	TYPE	DATE	LC50	REMARKS
combined + clean water	comp.	810805	34	
combined + clean water	comp.	810811	70	72 hr. LC50
combined + clean water	comp.	810818	49	
combined + clean water	24hr composite	840709	54.1	45.9-63.8
combined + clean water	24hr composite	840807	71.9	62.3-83.1
combined + clean water	24hr composite	850605	42.5	
combined + clean water	grab	850710	54.1	

James River Marathon Limited, Marathon, Ontario

James River Marathon Limited, (formerly American Can of Canada Ltd.), Marathon, Ontario

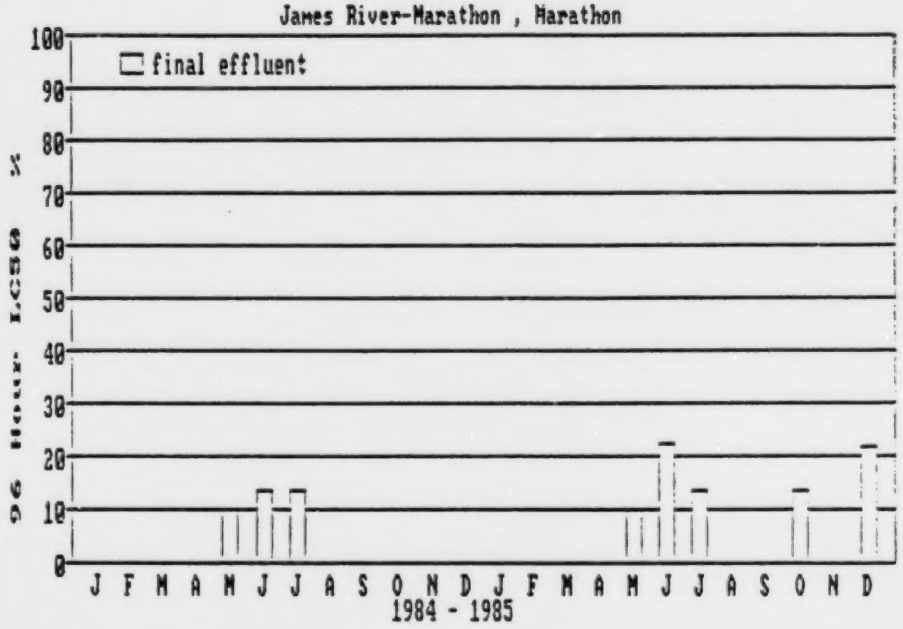
Receiving watercourse: Peninsula Harbour, Lake Superior

flow:	69040	cu m/day	BOD:	13200	Kg/day
PHOS:	30.9	Kg/day	DS:	88400	Kg/day
SS:	4520	Kg/day			

The mill's effluent is highly toxic to fish. Nine bioassays conducted in 1985, indicated that, statistically, the percentage effluent required to kill 50% of the fish by four days exposure ranged from 5.4% to 22.6%. The effluent remains toxic despite excessive water use and recent mill renovations.

The mill was constructed in 1945 as Marathon Paper Mills of Canada. Both hardwood and softwood logs and chips are made into bleached kraft pulp. The mill consists of dry debarking, digestors/cleaners/washers, bleaching and pulp sheet formation. The source of mercury contamination have been eliminated with the shutdown of the chlor-alkali plant in 1977. The company has installed an eighth digester, modernized the recausticizing area and installed a new chlorine dioxide generator and extraction stage washers. Scrubbers were installed on the lime kiln and the tall oil reactor. A foam retention lagoon and diffuser was installed in 1984. On April 25, 1984, a Control Order was served on James River Marathon Ltd.

Boatty Cove
Neuve Chapelle Point
PENINSULA
Ypres Pt
Yser Pt
Blondin Island
HARBOUR
Skin
Hawkins Island
The Peninsula
PENINSULA HILL
Marathon
PIC TP
C.P.
Gravel Pit
Golf Course
XI
X
IX
VIII
VII
1000
750
650
CRAIGS PIT
CANADIAN PACIFIC
20,19
19



James River-Marathon, Marathon

SITE	TYPE	DATE	LC50	REMARKS
final	12hr composite	830606	23	100% mortality at 65%
final	12hr composite	830706	42	70% mortality at 45%
final	12hr composite	830803	71	30% mortality at 65%
final	composite	840515	10	less than 10 %
final	grab	840515	11	
final	composite	840515	31.8	
final	composite	840516	10	less than 10 %
final	composite	840519	13.4	
final	composite	840519	13.4	
final	composite	840528	74.8	
final	composite	840710	13.4	
final	grab	850514	10	<10
final	grab	850514	6.1	
final	grab	850516	10	<10
final	grab	850516	5.4	
final	24hr composite	850527	22.6	
final	24hr composite	850715	13.4	
final	24hr composite	850729	13.4	
final	24hr composite	851010	13.4	
final	24hr composite	851216	21.6	17.8-26.3
final	grab	840516	16.9	
final	3hr composite	840712	16.6	100% mortality in 100-20%

Samples collected under former owner
American Can of Canada Ltd.

Site	Type	Date	LC50	Remarks
acid bleachery	8 hr comp	780509	35	pH adj. to 7.4
acid bleachery	8 hr comp	780509	25.5	
acid filtrate	4 hr comp	780928	10	pH adj. to 6.2
acid filtrate	16 hr comp	800715	3	
barkpress	4 hr comp	780928	49	pH adj. to 6.2
caustic bleacher	8 hr comp	780509	24.5	LC50 20-30 %
caustic bleacher	8 hr comp	780509	41	pH adj.to 7.8 %
caustic filtrate	4 hr comp	780928	49.9	pH adj.to 6.3
combined mill effluent	8 hr comp	780509	100	
combined mill effluent	4 hr comp	780928	55.6	pH adj. to 6.1
combined mill effluent	comp. of gra	791014	59	
combined mill effluent	4 hr grab co	800325	63	
combined mill effluent	16 hr comp	800715	24	acid spill in plant
combined mill effluent	24 hr comp	800812	82	
combined mill effluent	12 hr comp	810616	30	30% LT100 96 hrs
combined mill effluent	4 hr comp	810818	45	
combined mill effluent	2.5 hr comp	810824	14	
combined mill effluent	grab	820819	4.2	
combined mill effluent	grab	820819	4.2	
combined mill effluent	grab	821217	54.1	
conden. from sur.condensor	16 hr comp	800715	7	
effluent from clarifier	4 hr comp	780928	63	pH adj. to 6.3
effluent to clarifier	4 hr comp	780928	22.6	pH adj. to 6.0
exc. bleach plant filtrate	4 hr comp	780928	0.55	pH adj.to 6.3
foul water from digester	4 hr comp	780928	3.2	pH adj. to 6.3
machine room effluent	4 hr comp	780928	100	non-lethal pH adj to
main mill effluent	8 hr comp	780509	51	LC50 45-65 %
main mill effluent	8 hr comp	780509	100	100 % LT100 48 hrs
main mill effluent	4 hr comp	780928	63	pH adj. to 6.3
main mill effluent	16 hr comp	800715	60	
main mill sump	8 hr comp	780509	41.6	
main mill sump	8 hr comp	780509	100	100% LT100 2 hrs
recovery furnace sewer	4 hr comp	780928	68	pH adj. to 6.3
recovery furnace sewer	4 hr comp	780928	53.3	pH adj.to 6.3
unbleached white water	4 hr comp	780928	11.6	pH adj.to 6.3
woodroom effluent	4 hr comp	780928	100	non-lethal pH adj
# 1 evaporator condensate	4 hr comp	780928	3.2	pH adj. to 6.3
# 2 evaporator condensate	4 hr comp	780928	16.6	pH adj.to 6.6
# 2 evaporator condensate	4 hr comp	780928	100	non-lethal pH adj

Kimberly-Clark of Canada, Huntsville

Kimberly-Clark of Canada, Huntsville

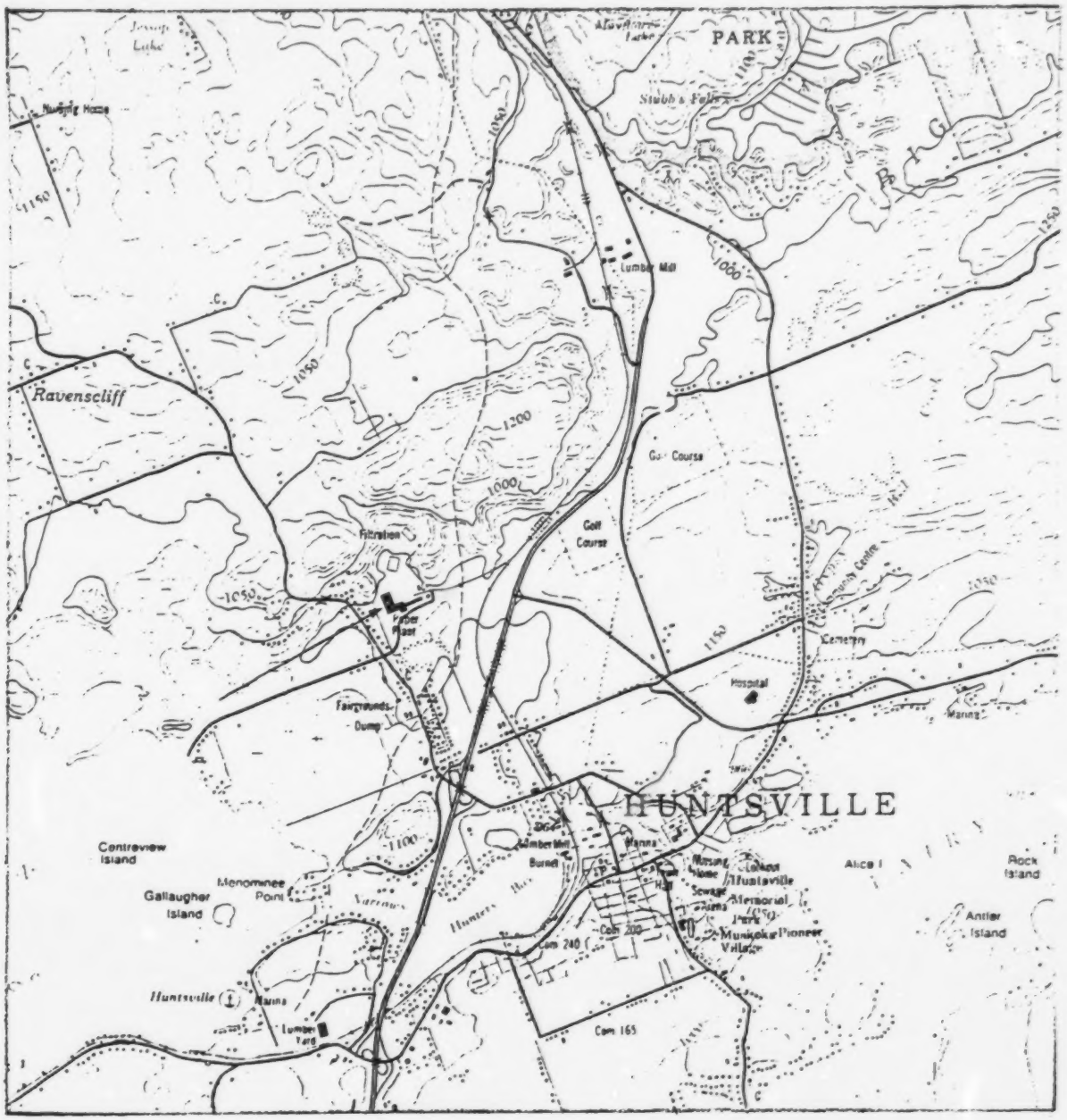
Receiving watercourse: Muskoka River

flow:	864 cu m/day	BOD:	68.3 Kg/day
PHOS:	0.005 Kg/day	DS:	4.07 Kg/day

No toxicity bioassays have been conducted in the past two years. It, therefore, is difficult to evaluate how well the treatment facilities are operating. The siting of the mill in the Muskoka's vacation heartland was the subject of so much public interest and occasional controversy that the waste treatment facilities were designed using 'Best Available Technology'. The company cooperated with all Ministry requirements and scrupulous pre- and post-operational surveys were carried out. Up to 80% of the process water is treated and re-used. Spray irrigation of discharged water eliminates waste input to the river for 6 months of the year. An intensive public relations operation, recruitment of local people and lack of environmental impact made for relatively trouble-free implementation.

In March 1971 the first paper machine started operations. Since that time several converting lines have been installed in the mill. Mill consists of repulpers, cleaners and papermaking. Purchased pulp is converted into tissue and presently is the largest tissue mill in Canada.

The secondary treatment equipment - percolating beds - are constantly plugged. Alternatives to the existing secondary treatment system are being considered by company officials. Whitewater is recycled through a disk saveall, then to a large clarifier with 80% recycle. Effluent is then sent to a sealed polishing basin with aerated overflow. In non-freezing periods, groundwater is recharged through the irrigation of percolating beds. During the winter, water is discharged through a foam trap and submerged diffusers, then to the river. A septic tank system is used for sanitary wastes.


PARK
Ravenscliff
Golf Course
Golf Course
Lumber Mill
Fairgrounds
Dump
Cemetery
Hospital
HUNTSVILLE
Centreview Island
Gallaugher Island
Menominee Point
Huntsville
Marina
Lumber Yard
Memorial Park
Antler Island
Rock Island
Alice I
Com 240
Com 200
Com 165
1050
1100
1150
1200
1000

Kimberly Clark , Huntsville

Site	Type	Date	LC50	Remarks
lagoon	grab	800505	93	

Kimberly-Clark of Canada Ltd., St. Catharines

Kimberly-Clark of Canada Ltd., St. Catharines

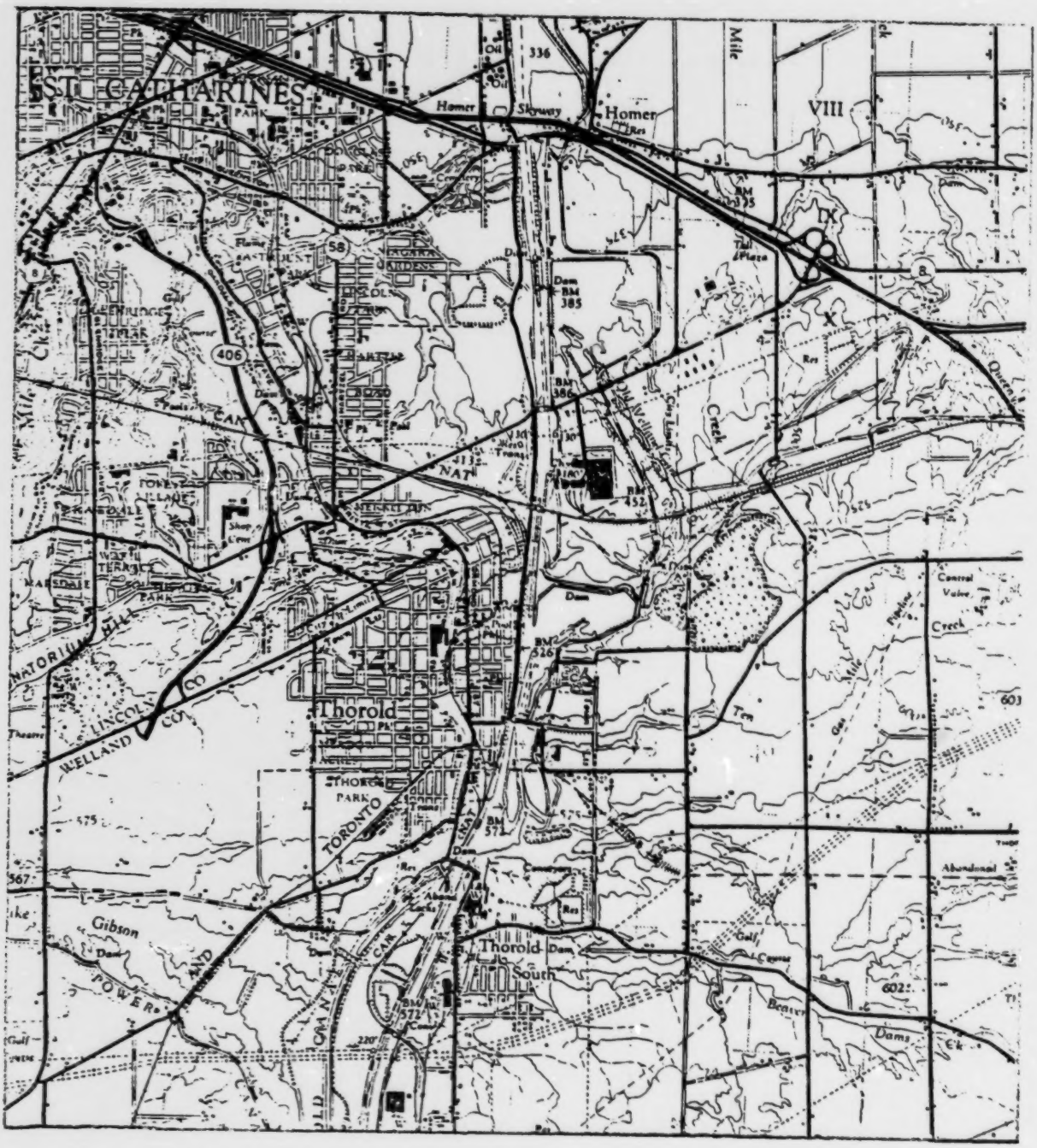
Receiving watercourse: Discharges into an open section of the Old (second) Welland Canal and thence to Twelve Mile Creek and Lake Ontario.

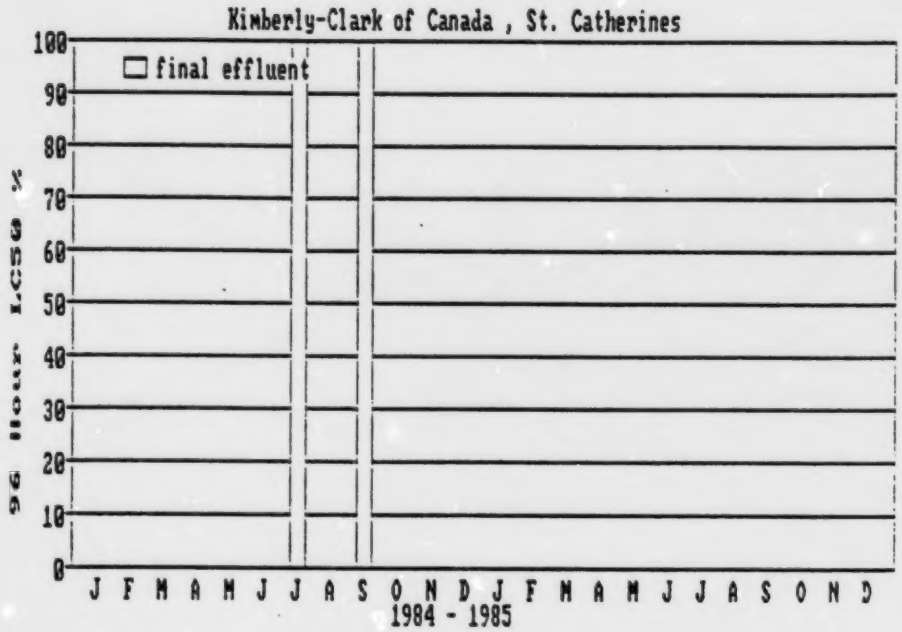
flow:	9240	cu m/day	BOD:	430	Kg/day
DS:	660	Kg/day	SS:	58	Kg/day

Two trout bioassays, performed in 1984 indicated that the final effluent was not acutely lethal to test fish. High bacteria counts of Klebsiella pneumoniae and Pseudomonous aeruginosa were found in the Old Welland Canal. Sources have been identified by West Central Region staff in the 1984 survey.

The mill originally started as a groundwood mill due to cheap electricity, early in the century. Currently there is no pulping and the three paper machines operate on dry purchased furnish. Economic viability of mill depends upon using clean waste paper. Purchased pulp and clean used paper is converted into tissue, towelling and crepe wadding, etc. The mill consists of broke beaters, cleaners and papermaking (2 paper machines). A paper machine was extensively rebuilt with local initiative and engineering skills in the late 1970's to dramatically reduce water usage on the mill, a unique achievement for Canada. The aesthetic problem, associated with the paper mills' discharges, of the Old Welland Canal is highly visible due to residential areas overlooking the canal. The BOD loading is still above the interim objective set in the Program Approval due to the additional use of secondary pulp or clean wastepaper.

The company is investigating methods to reduce the BOD load in the effluent through Kimberly-Clark's engineering group in the U.S.A. In 1984, the mill began to use the effluent polishing ponds again. Effluent is treated by a reactor clarifier and polishing ponds. This appears to be successful in lowering the loadings of TSS and BOD. New shower heads, new pulp chest, water conservation, and the new paper machine are part of the abatement system.


ST. CATHARINES
Homer
Skyway
Homer
VIII
IX
Mile
Creek
Thorold
Thorold South
Gibson
LINCOLN CO.
WELLAND CO.
TORONTO
POWER
Dams
Creek
Abandoned



Kimberly-Clark of Canada , St. Catharines

Site	Type	Date	LC50	Remarks
final effluent	grab	760517	58	unaerated
final effluent	grab	760517	100	non-lethal
final effluent	grab	770228	100	non-lethal
final effluent	grab	800423	100	non-lethal
final effluent	grab	840710	100	:non-lethal
lagoon #2	grab	840928	100	non lethal

Kimberly-Clark of Canada, Terrace Bay

Kimberly-Clark of Canada, Terrace Bay

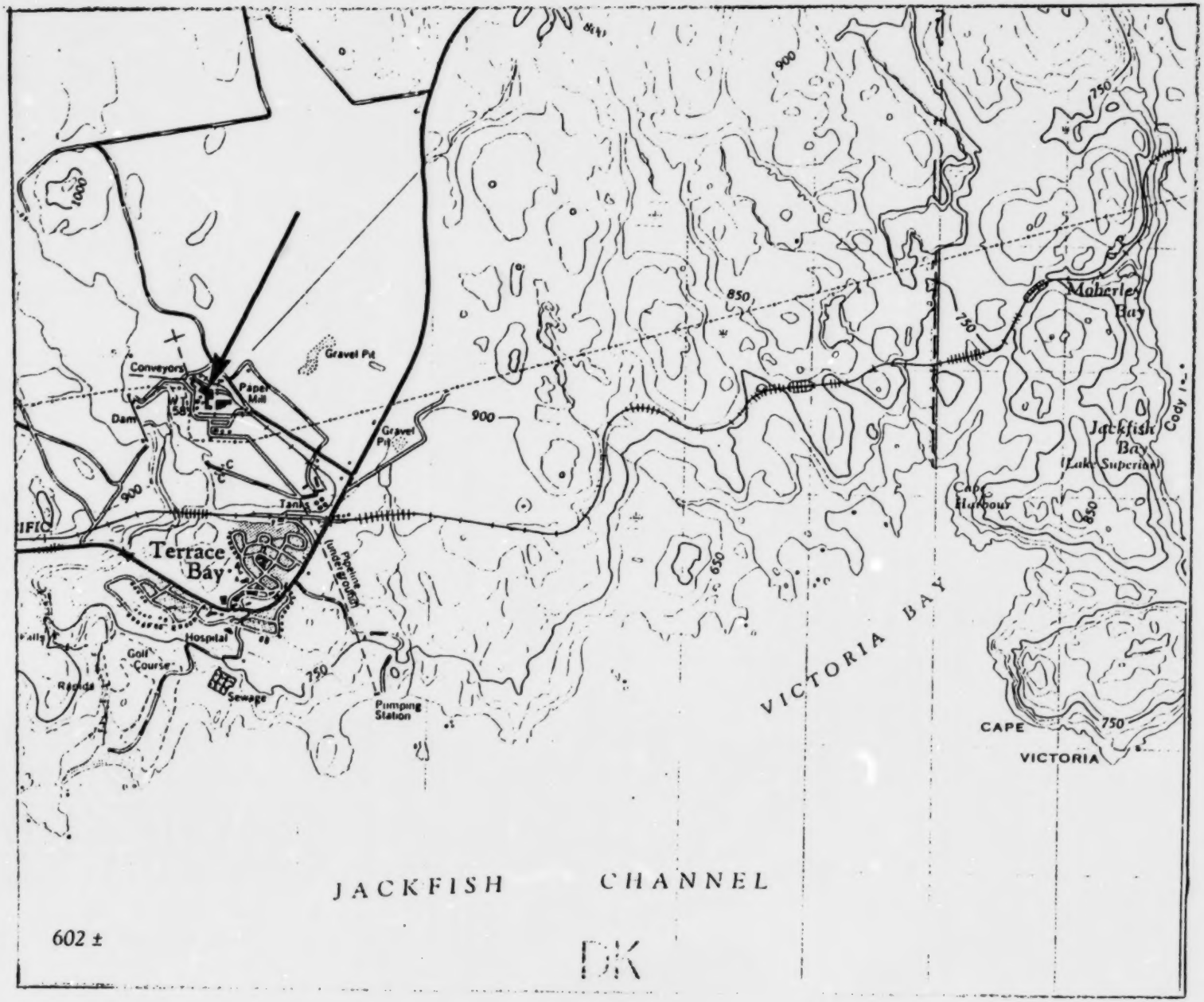
Receiving watercourse: Blackbird Creek, Moberly Bay, Lake Superior

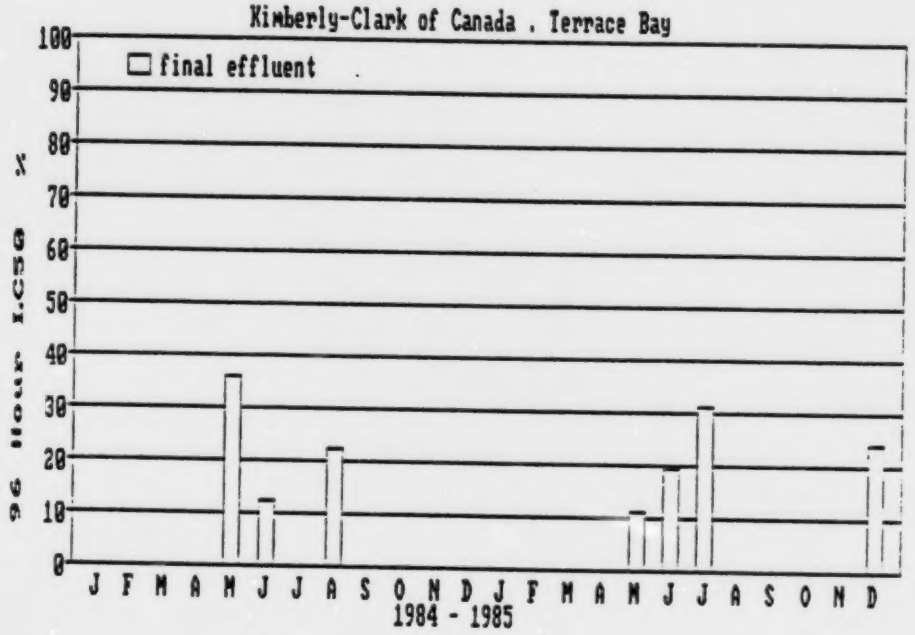
flow:	119000	cu m/day	BOD:	35000	Kg/day
PHOS:	59.4	Kg/day	DS:	163000	Kg/day
SS:	5820	Kg/day			

The discharge is highly toxic to fish. Seven trout bioassays, performed in 1985 indicated that, statistically, the concentration of effluent required to kill 50% of test fish in a four day exposure ranged from 11% to 31%. Extensive surveys of the plume and its zone of influence have been compiled by the Great Lakes Section and confirm that aesthetic problems in Moberly Bay are associated with benthic perturbations, high phenolics concentrations and sediment accumulations of fibre. The plume has been detected at the Terrace Bay drinking water intake. Blackbird Creek plus the associated small lakes system are so polluted from past discharge that they are now contributing to the contamination of Moberly Bay. An intensive study of the effluent and Moberly Bay was made in 1982 including the use of caged fish indicated the lethal zone extends some distance from the mill.

The original mill had an initial design capacity of 320 megagrams per day. Production increased steadily to just under 400 megagrams per day. Planning for the new kraft mill started in the early 1970's and construction was initiated in 1975, increasing the design capacity to 1,135 megagrams per day. From the startup of the expanded mill in 1978 to the mill fire in October, 1981, the design capacity was not achieved. During the reconstruction after the fire, several operational changes were incorporated. Production increased steadily after the March, 1982 startup and it is presently above design capacity. Logs and chips are converted by two kraft mills into bleached pulp. The mills consist of dry debarking, kraft pulping (digesters/cleaners/-washers), kraft bleaching and pulp sheet formation.

The bleachery besides being countercurrent flow is designed for "closure". An extensive spill collection system was installed by mid 1984. Further modifications to the spill collection system are being undertaken as well as pH neutralization. Methods to reduce the discharge from the bleachery are being investigated. Spill control, recycle system and spill detection system have been installed as part of the abatement system.


Terrace Bay
Paper Mill
Conveyors
Gravel Pit
Dam
Tanks
Hospital
Golf Course
Sewage
Pumping Station
Pipeline (under Ground)
Maherley Bay
Jackfish Bay (Lake Superior)
Cape Harbour
VICTORIA BAY
CAPE VICTORIA
JACKFISH CHANNEL
602 ±
DK



Kimberly-Clark of Canada , Terrace Bay

SITE	TYPE	DATE	LC50	REMARKS
acid sewer	24hr composite	850624	10	<10
alkaline sewer	24hr composite	850624	45.6	
bridge at lake A	grab	810722	14	
bridge at lake A	grab	810728	35	
culvert at Hwy. 17	2.5 hr grab com	800730	47	
culvert at Hwy. 17	4 hr grab comp.	800805	37	
culvert at Hwy. 17	24 hr grab comp	800812	30	
culvert at Hwy. 17	24 hr grab comp	800819	35	
culvert at Hwy. 17	20 hr comp.	810721	13	
culvert at Hwy. 17	24 hr comp.	810722	6	
culvert at Hwy. 17	24 hr comp.	810723	7	
culvert at Hwy. 17	24 hr comp.	810724	12	
culvert at Hwy. 17	24 hr comp.	810725	11	
culvert at Hwy. 17	24 hr comp.	810726	9	
culvert at Hwy. 17	24 hr comp.	810727	9	
culvert at Hwy. 17	24 hr comp.	810728	17	
culvert at Hwy. 17	4hr composite	830607	35	pH adjusted to 6.5
culvert at Hwy. 17	4hr composite	830607	17	100% mortality at 65%
culvert at Hwy. 17	grab	830706	14	100% mortality at 65%
culvert at Hwy. 17	grab	830710	18	100% mortality at 65%
culvert at Hwy. 17	grab	830711	8	
culvert at Hwy. 17	24hr composite	830711	22	pH adjusted to 7.0
culvert at Hwy. 17	24hr composite	830711	14	100% mortality at 65%
culvert at Hwy. 17	grab	830711	12	pH adjusted to 6.5
culvert at Hwy. 17	24hr composite	830712	26	100% mortality at 65%
culvert at Hwy. 17	24hr composite	830712	30	pH adjusted to 6.5
culvert at Hwy. 17	grab	830713	19	100% mortality at 65%
culvert at Hwy. 17	grab	830714	42	60% mortality at 65%
culvert at Hwy. 17	2hr composite	830803	38	90% mortality at 65%

Kimberly-Clark of Canada , Terrace Bay

SITE	TYPE	DATE	LC50	REMARKS
discharge to Moberly Bay	grab	800805	22	
discharge to Moberly Bay	grab	800811	30	
discharge to Moberly Bay	grab	800819	20	
discharge to Moberly Bay	grab	810623	81	taken in bay
discharge to Moberly Bay	grab	810625	81	taken in bay
discharge to Moberly Bay	grab	810723	8	
discharge to Moberly Bay	grab	810724	11	
discharge to Moberly Bay	grab	810725	13	
discharge to Moberly Bay	grab	810726	21	
discharge to Moberly Bay	grab	810727	15	
discharge to Moberly Bay	grab	810728	21	
discharge to Moberly Bay	grab	810729	17	
discharge to Moberly Bay	grab	810730	14	
final	composite	840530	35.7	29.1-43.9%
final	composite	840626	12.5	
final	composite	840626	12.5	
final	composite	840813	22.6	20.3-25.3 %
final	composite	840813	22.6	20.3-25.3 %
final	4 hr. composite	840814	19.6	hard water dilution
final	4 hr. composite	840814	3.5	soft 4.0ppm water diluti
final	4 hr. composite	840821	11.9	soft 40.ppm dilution wat
final	24hr composite	850515	10.0	
final	24hr composite	850610	24.0	
final	24hr composite	850610	19.4	
final	24hr composite	850617	20.2	
final	24hr composite	850624	31.0	
final	24hr composite	850909	40.1	
final	24hr composite	850909	24.0	
final	24hr composite	850913	42.8	
final	24hr composite	850913	45.6	
final	24hr composite	851202	24.0	
last highway crossing	grab	810722	6	
last highway crossing	grab	810728	54	
last highway crossing	grab	810824	38	soft water used to dilute
last highway crossing	grab	810824	44	hard water used to dilute
last highway crossing	grab	810824	44	
last highway crossing	grab	810824	67	stored for 2 days
Moberly Bay (EX-1)	grab	830710	100	50% mortality at 100%
Moberly Bay (EX-1)	grab	830712	37	
Moberly Bay (EX-1)	grab	830713	35	
Moberly Bay (EX-1)	grab	830714	59	
pulp mill effluent	grab	770809	39	LC50 range 30-50 %
#1 brown stock	24hr composite	850624	15.1	

MacMillan Bloedel Ltd., Sturgeon Falls Division, Sturgeon Falls

MacMillan Bloedel Limited, Sturgeon Falls Division, Sturgeon Falls

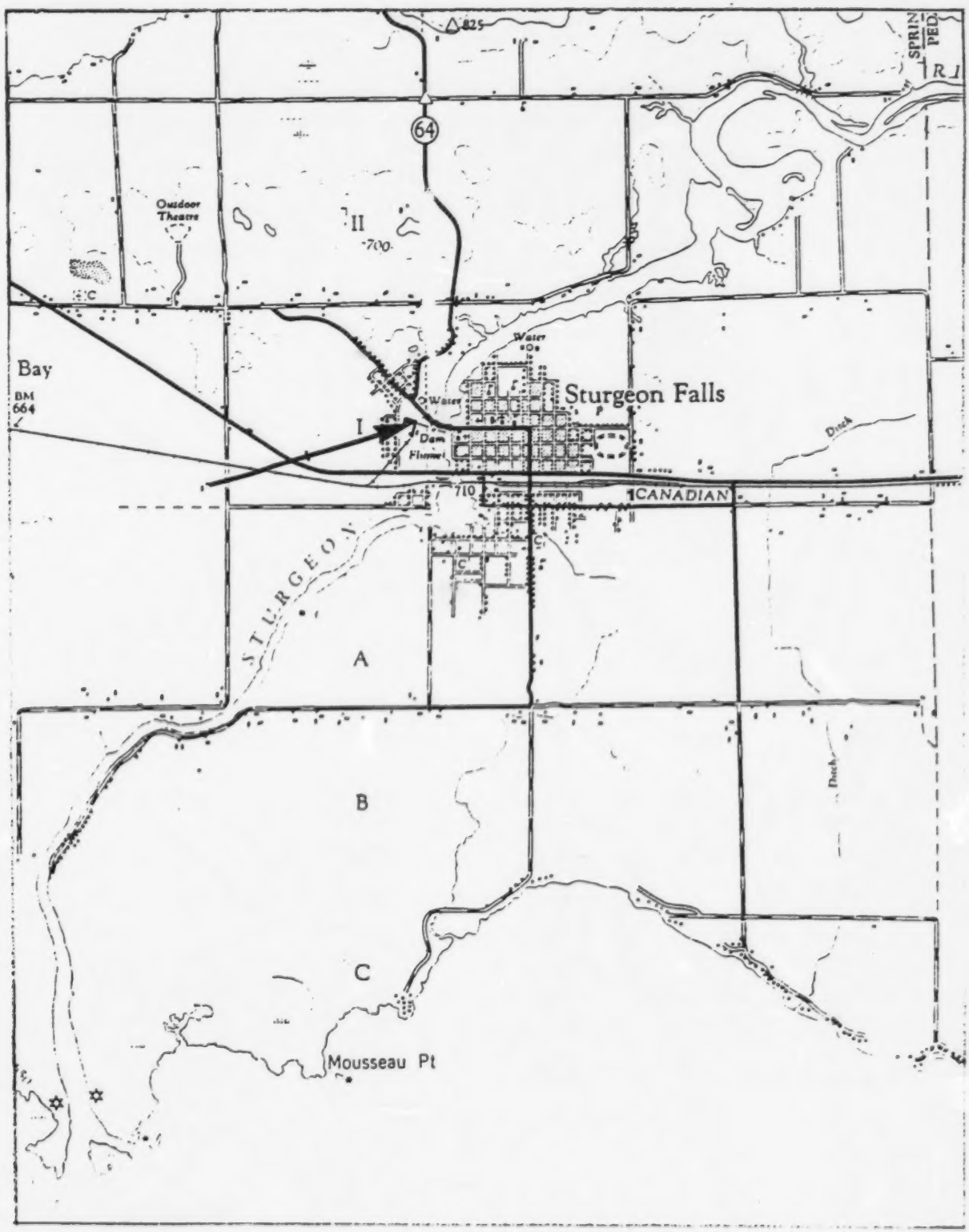
Receiving watercourse: Sturgeon River to Lake Nipissing/Lake Huron

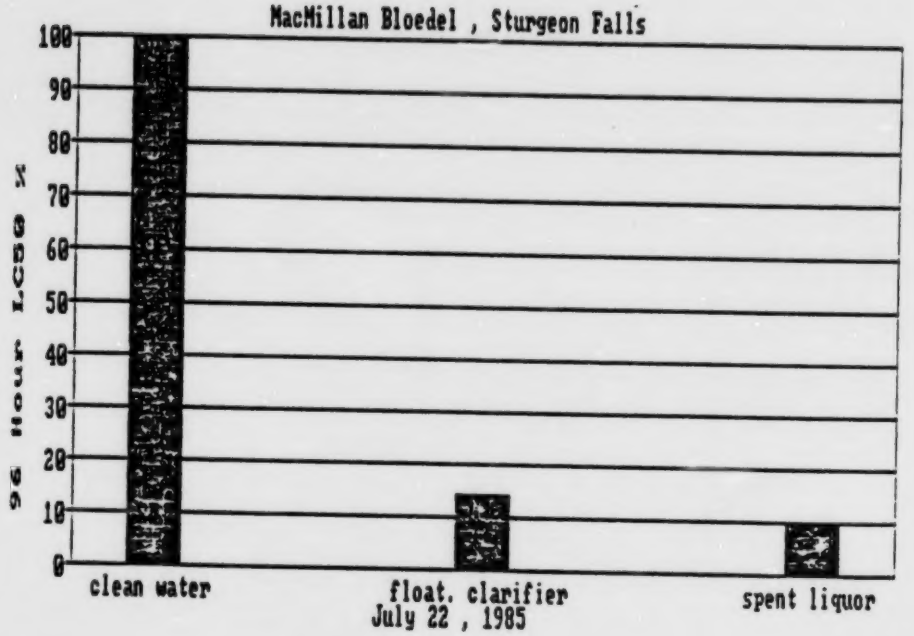
flow: 11400 cu m/day BOD: 41800 Kg/day
SS: 2430 Kg/day

The mill effluent is highly toxic to fish. One trout bioassay, performed in 1985, indicated that it would take, statistically 14.2% effluent to kill 50% of the fish by the end of four days exposure.

Formerly Abitibi Paper Company Ltd, Sturgeon Falls Division, the Mill was sold to MacMillan Bloedel in November, 1979. The Mill did not operate between 1930 and 1947. Chips are made into corrugating medium and hardboard. The corrugating medium mill consists of chip washing neutral sulphite semi-chemical (NSSC) pulping and sheet formation. Hardboard siding is made using thermal mechanical refining and glueing.

Anaerobic treatment system may prove to be an economically and technically sound abatement solution. Other alternatives such as chemical recovery and aerobic treatment have been deemed to be cost prohibitive by the company. Additional BOD removal and toxicity reduction will be required. Company received federal financial assistance to do anaerobic evaluation and design. Pilot plant was built and started up May 1986. The company is required to submit an application for a certificate of approval covering an aerobic treatment works by December 31, 1987. Runoff of phenol from use of phenolic resin in hardboard mill is controlled by improved adjustment of mill equipment. Suspended solids are removed from the effluent by a storage settling tank/flotation clarifier system.


825
SPRING PED.
RI
64
Outdoor Theatre
II
700
Water
Bay
BM 664
Water
Sturgeon Falls
I
Dam
Flume
Ditch
710
CANADIAN
STURGEON
A
B
C
Ditch
Mousseau Pt



MacMillan Bloedel,Sturgeon Falls

SITE	TYPE	DATE	LC50	REMARKS
black liquor	grab	820211	7.6	
black liquor	grab	820505	3.4	
clean water	grab	820211	47	
clean water	grab	820505	54	
clean water	grab	850722	100	>100
combined effluent	grab	820212	15	
combined effluent	grab	820507	14	
flotation clarifier	grab	820211	14	
flotation clarifier	grab	820505	17	
flotation clarifier	grab	850722	14.2	
spent liquor	grab	850722	10	<10

Abitibi-Price, Sturgeon Falls

SITE	TYPE	DATE	LC50	REMARKS
floatation clarifier	grab	791126	45	
floatation clarifier	grab	791126	50	
heavy solids sewer	grab	791126	3.5	
Intake	grab	791126	100	non- lethal
spent sulfite liquor	grab	790815	3	less than 3.%
spent sulfite liquor	grab	791126	5.4	
uncontaminated sewer	grab	791126	100	non-lethal
uncontaminated sewer	grab	791126	100	non-lethal

Ontario Paper Company, Thorold

Ontario Paper Company, Thorold

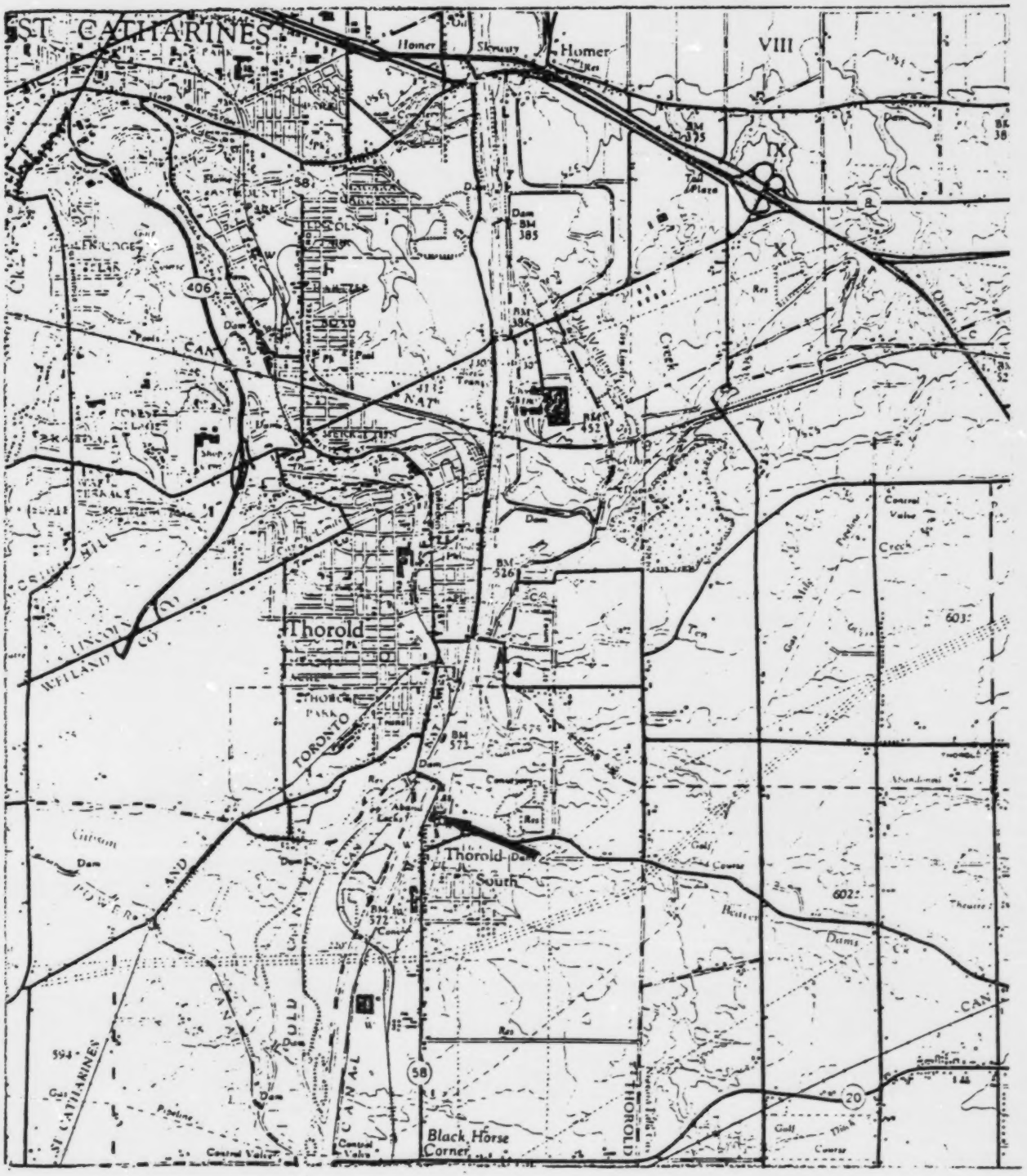
Receiving watercourse: Old Welland Canal, Twelve Mile Creek, Lake Ontario

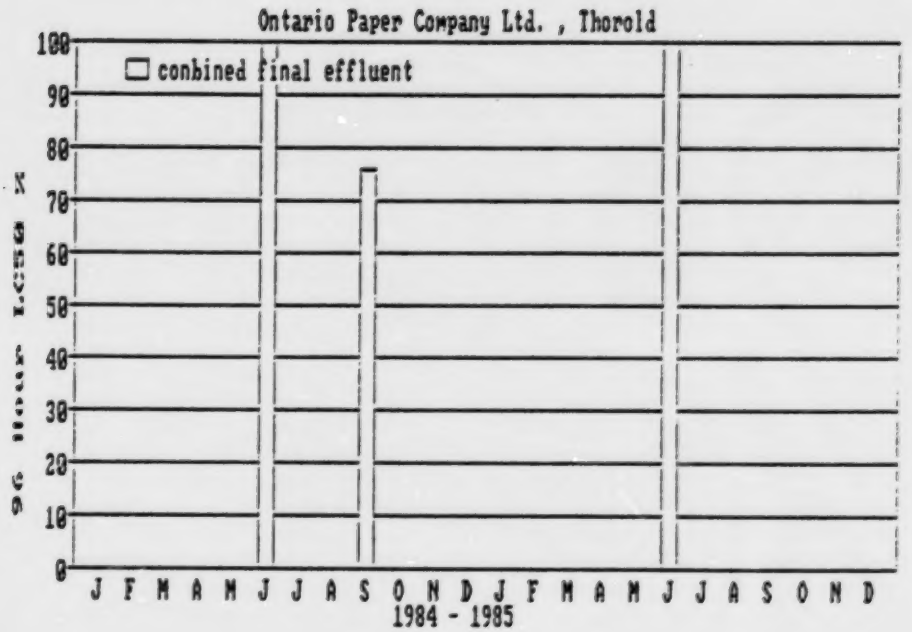
flow:	115100	cu m/day	BOD:	12800	Kg/day
DS:	58000	Kg/day	SS:	5230	Kg/day

The effluent does not normally kill fish. A bioassay conducted in 1985 indicated the effluent was not acutely lethal to fish. High bacteria counts of Klebsiella pneumoniae and Pseudomonous aeruginosa are found in the Old Welland Canal. Sources have been identified by West Central Region staff in the 1984 survey.

The mill is unique in Canada in having an operational chemical recovery system with commercial by-products including ethanol (1943), vanillin (1952) and saltcake (1973), the latter from the Copeland process which concentrates and incinerates weak chemical wastes from the sulphite process. A major renovation and expansion has replaced five newsprint machines by two modern, high speed machines with TMP, CMP, sulphite and waste deinked newsprint feedstock. Logs and newspapers are made into newsprint. The wood is rewashed before being processed by Thermo Mechanical, Sulphite and chemi-mechanical pulping. Mechanical pulps are brightened. This is the only Canadian mill that deinks waste newspapers. Speciality chemicals, vanillin and alcohol are produced from sulphite liquor. Hardwood is used for chemi-mechanical pulping; softwood, thermo-mechanical and sulphite pulping.

The mill began operation in 1913. Operational problems were experienced during the transition from the old pulping processes and paper machines to their replacements. Losses of process materials are now in compliance. Some foaming problems remain. There is also concern with odour emissions from the Chemical Recovery Plant and SO_2 from the Acid Plant and Digester blow stack. Improved containment and treatment of spills during scheduled shutdowns are essential. Company has started new modernization construction. The effluent Waste Treatment Plant including chemical recovery has significantly reduced foam and colour except for spills and malfunctions. It comprises primary clarification, sludge, mud and lignin handling, containment facilities and the UNOX oxygen activated sludge system. Chemicals recovered are alcohol, vanillin and saltcake. Copeland system incinerates raffinate and excess liquor wastes from Waste Sulfite Liquor and the alcohol plant. An ion exchange plant recovers sodium. Spill controls are operated by staff trained in start up and shut down procedures. Sewer separation to prevent loss of 'dirty' wastes continues. 1981 UNOX secondary treatment system treats pulp and paper effluent. However, the foaming problem with the effluent from the new deinking mill is still to be resolved. A new, enlarged deinking plant, using a different process is being installed. Shutdown, boilouts, clarifier repairs, etc. are easily detected in effluent.


ST. CATHARINES
Homer
Skyway
Homer
VIII
IX
X
406
CAN
NAT'L
Dam
BM 385
BM 386
BM 452
BM 526
BM 575
BM 572
Creek
Thorold
WELLAND CO
LINCOLN CO
TORONTO
Thorold South
Black Horse Corner
58
20
CANAL
WELLAND CANAL
ST CATHARINES
THOROLD
603
602
Dams
Gulf Course
Control Valve



Ontario Paper Company Ltd , Thorold

Site	Type	Date	LC50	Remarks
copeland condensates	grab	790813	62	
final effluent	grab	760517	24	LC50 range 18-32 %
final effluent	grab	770228	100	non-lethal
final effluent	grab	770517	76	
final effluent	grab	790104	100	greater than 100 %
final effluent	grab	790813	100	non-lethal
final effluent	grab	840612	100	
final effluent	grab	840919	76	
final effluent	grab	850610	100	>100
groundwood white water	grab	790813	24	LC50 range 18-32 %
Na sulfite white water	grab	790813	32	LC50 range 18-56 %
receiving water	grab	790104	100	non-lethal
receiving water	grab	790813	100	non-lethal

Spruce Falls Power and Paper Co., Kapuskasing

Spruce Falls Power and Paper Co., Kapuskasing

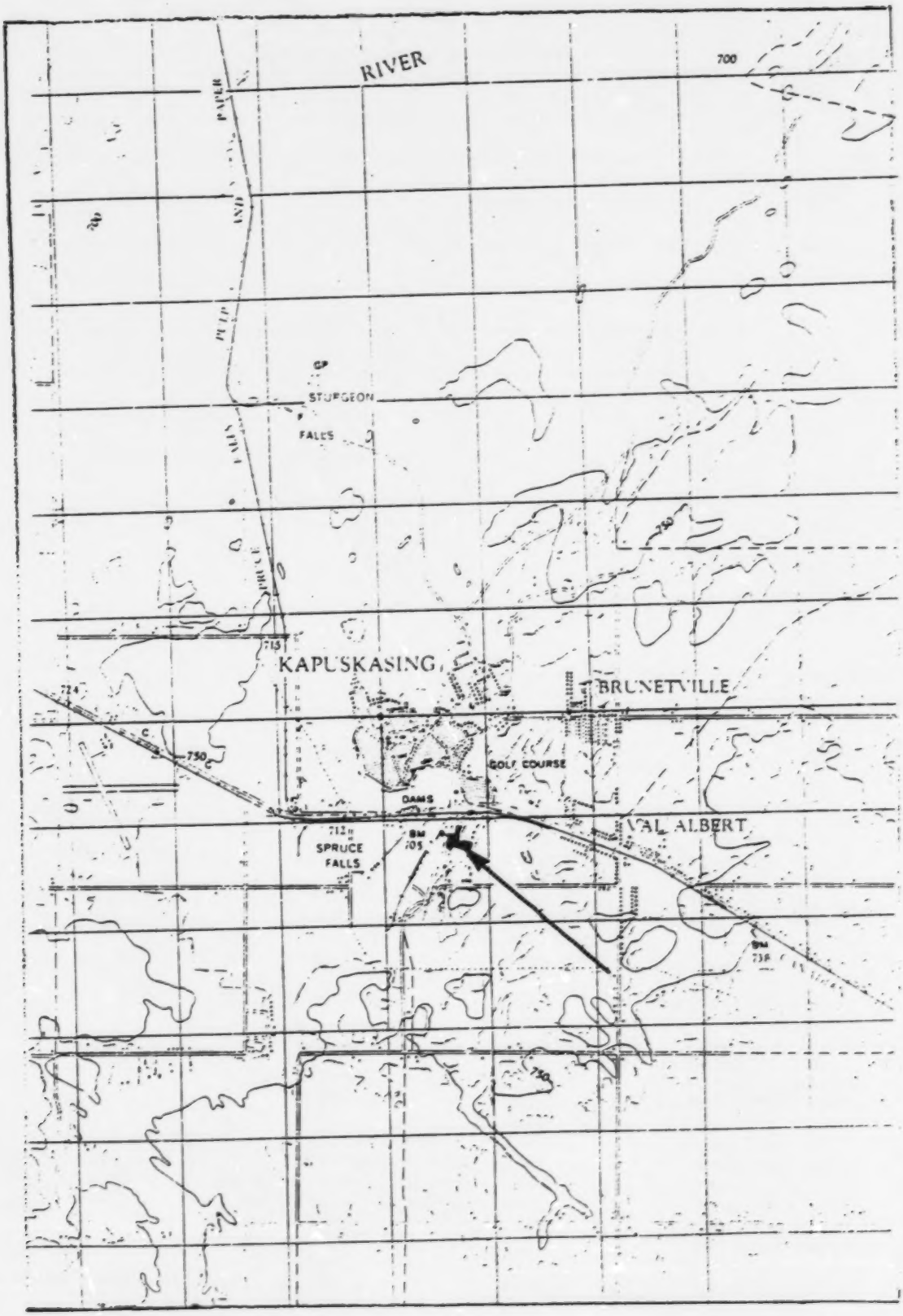
Receiving watercourse: Kapuskasing River, James Bay

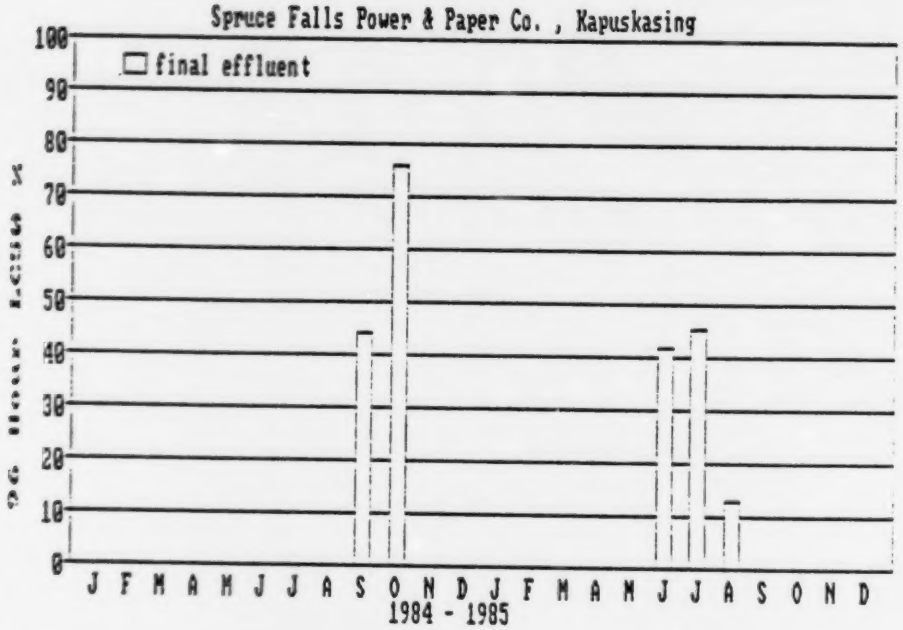
flow: cu m/day BOD: 25200 Kg/day
SS: 7400 Kg/day

The mill effluent is toxic to fish. Four trout bioassays, performed in 1985, indicated that it would take, statistically, 43%, 46%, 59% and 13% effluent to kill 50% of the fish by the end of four days exposure. River driving logs to the mill has resulted in heavy bark deposits up-stream of the mill. The calcium sulphite mill was shut down November 1982. Over the last 10 years, reductions of 71% for BOD_5 and 86% for suspended solids have been achieved. During summer, river flow may be extremely low resulting in a depressed dissolved oxygen content and a reduced assimilative capacity of the river.

Mill and its own hydro-electricity generating plant were built during 1919- 1920. The mill began operations with a calcium sulphite mill in 1922; this process was shutdown in 1982. In 1928, the groundwood and 4 newsprint machines started production. In 1964 a new Magnetite mill, was constructed. Magnetite is a magnesium sulphite mill which has spent liquor recovery. In 1973 a stud mill was built; chips are used in the sulphite pulping mills. A 200 ton/day thermo-mechanical pulp mill was started up in 1976 and expanded to 360 tons per day in 1981. The adjacent Kimberly-Clark tissue mill was closed in 1983. The company operates two dams on the Kapuskasing and Mattagami River. Logs and chips are made into newsprint. The mill consists of wet drum debarking, wood rewashing, chip washing, pulping - stone groundwood, thermo-mechanical and magnefite sulphite (magnesium sulphite) processes, thermal mechanical bleaching and papermaking (4 paper machines). A repulper has been installed so that purchased Kraft pulp can be used.

A high rate anaerobic system is being proposed for concentrated BOD wastewater streams; a pilot plant anaerobic unit has been in operation since October, 1986. To meet air and water improvements, both process changes and conventional air and water abatement equipment have been installed. A bark fines clarifier was installed in 1971 and a process waste clarifier in 1981. This is the only mill with a clarifier shed enclosure in Canada. Thus scum removal is operational all year. A centralized broke and whitewater system was installed. Clarifier sludge is dewatered and burned. Sanitary wastes are segregated and treated by the company and the municipality. In-plant changes are being proposed which will reduce fresh water usage, concentrate the BOD loads and maximize white water usage for pulp washing. The company will select options from the Pulp and Paper Research Institute work (on going since 1982) for implementation in 1986 and beyond.


RIVER
700
PAPER
STURGEON
FALLS
KAPUSKASING
BRUNETVILLE
GOLF COURSE
DAMS
VAL ALBERT
SPRUCE
FALLS
BM
705
BM
738
750



Spruce Falls Power & Paper Co,Kapuskasing

SITE	TYPE	DATE	LC50	REMARKS
4th stage reject liquor	grab	770614	2	2% LT100 24 hrs
4th stage reject liquor	grab	780715	3.6	
4th stage reject liquor	grab	780715	11.8	pH adjusted
Ca sulfite effluent	1 gr.every 5min/	790827	3.5	
Ca sulfite effluent	1 gr.every 5min/	790827	10	pH adjusted to 8
chip washer water	grab	770614	2	2% LT100 12 hrs
condensate stream	grab	791109	2.3	
final effluent	grab	821118	80.6	
final effluent	grab	830202	45.9	
final effluent	grab	830202	0	
final effluent	grab	830203	0	
final effluent	grab	830203	21.9	
final effluent	24 hr. composite	840919	44.2	70 ppm dilut. water
final effluent	24 Hr. composite	840928	76	70 ppm dilut. water
final effluent	24hr composite	850607	42.8	37.9-48.3
final effluent	24hr composite	850712	45.6	
final effluent	24hr composite/g	850712	59.1	
final effluent	24hr composite	850809	13.4	
groundwood mill stock liq	grab	770519	14	LC50 range 10-20 %
groundwood whitewater	grab	770519	100	non-lethal
groundwood whitewater	grab	790827	47.7	LC50 range 32.5-70 %
intake	grab	790827	100	non-lethal

Spruce Falls Power & Paper Co,Kapuskasing

SITE	TYPE	DATE	LC50	REMARKS
magnefite stream	grab	791119	13	LC50 range 9-18 %
main mill effluent	grab	760706	42	LC50 range 32-56 %
main mill effluent	grab	760706	22	unaerated
main mill effluent	grab	760720	14	unaerated 10-20 %
main mill effluent	grab	760720	14	LC50 range 10-20 %
main mill effluent	grab	760920	10	less than 10 %
main mill effluent	grab	760920	10	unaerated
main mill effluent	grab	790827	24	LC50 range 17.5-32.5 %
main mill effluent	grab	791119	37	
process warm water	grab	780715	100	10 % mortality in 100
pulp stock - no bleach	grab	770615	2	
pulp stock - with bleach	grab	770615	2	80 % mortality in 2 %
red liquor stream	grab	791119	1	
TMP chip washer	grab	780715	0.9	
TMP chip washer	grab	780715	1.7	pH adjusted to 6.5
TMP final effluent	grab	780715	3.2	LC50 range 2-5 %
TMP final effluent	grab	790827	1.2	
TMP stock liquor	grab	780715	2.3	
warmwater intake to TMP	grab	780615	100	non-lethal

St. Marys Paper Inc., Sault Ste Marie

St. Marys Paper Inc., (formerly Abitibi-Price Inc.), Sault Ste Marie

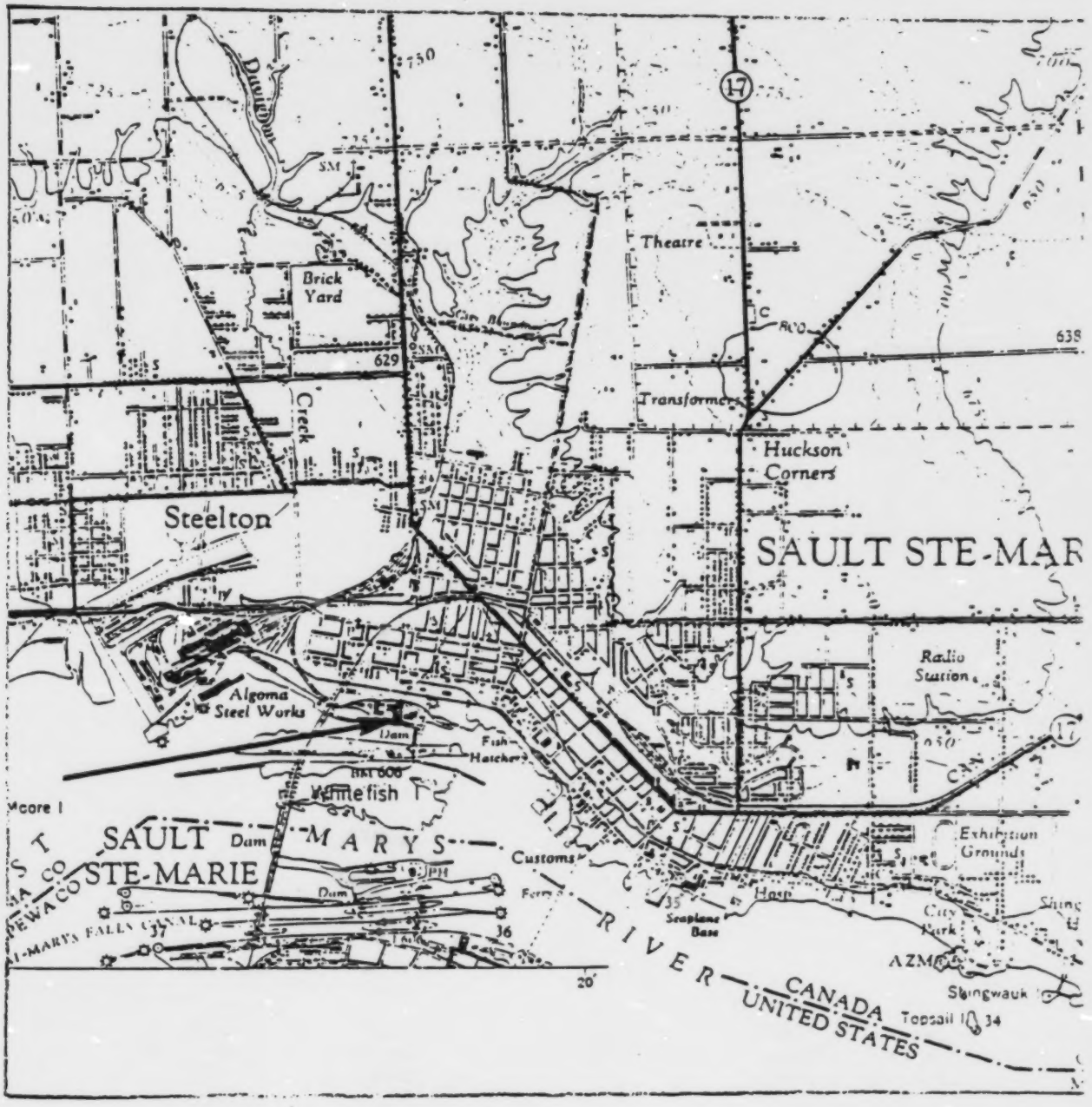
Receiving watercourse: St. Mary's River

flow: 28200 cu m/day BOD: 3600 Kg/day
SS: 3200 Kg/day

The mill effluent is toxic to fish. One bioassay performed in 1985, indicated that it would take, statistically, 29.1% effluent to kill 50% of the fish by the end of four days exposure. Environmental studies conducted by the OWRC in the early 1960's showed elevated levels of BOD and TSS entering the St. Mary's River from Abitibi's mill.

Mill was built near source of hydro-electricity generating plant in 1900. Originally, this mill produced newsprint on four paper machines using hydraulic driven groundwood and sulphite pulp. Major process changes through the years included an electrically driven groundwood mill in 1954, a switch to the manufacture of groundwood specialty paper (i.e. catalogue, directory, roto gravure) in 1955-56, a decommissioning of the sulphite mill and subsequent purchase of kraft pulp from Abitibi's Smooth Rock Falls Division in 1971-72 and the shutdown of #2 paper machine in 1984. In 1984-85 clay was continuously added to all grades of paper and a super calender was installed on two machine to permit a further diversification of groundwood specialty paper products. A new bleaching system, a new retention aid system, a starch cooker, a clay system for supercalenders, save all and a computer control system for stock preparation were installed at a cost of $19 million. Logs and purchased pulp are made into supercalendered (80,000 Megagrams per year) and a variety of clay-filled uncoated groundwood paper. Mill consists of wet drum debarking, groundwood pulping, groundwood brightening and paper making (3 paper machines).

The closure of their sulphite mill in 1971-72 and many inplant modifications led to an improvement in effluent quality. In 1974, under a Requirement and Direction, Abitibi was committed to install primary treatment facilities to meet Ministry effluent objectives. These efforts failed to achieve compliance, and in 1980, a Control Order was served. The Control Order requirements were complied with in 1983. Bark screens and drainer, bark fines recovery system and disc filters on paper machine waste waters were installed to reduce TSS. The original undersized flotation unit was replaced by a clarifier, scum collection devices and a submerged outfall in 1983.


Brick Yard
Creek
Steelton
Theatre
Transformer
Huckson Corners
SAULT STE-MAR
Radio Station
Algoma Steel Works
Dam
Fish Hatcher
Whitefish
SAULT STE-MARIE
Dam
MARYS
Customs
Ferry
Seaplane Base
Hosp
City Park
Exhibition Grounds
RIVER
CANADA
UNITED STATES
Topsail I.
Stingwauk
629
638
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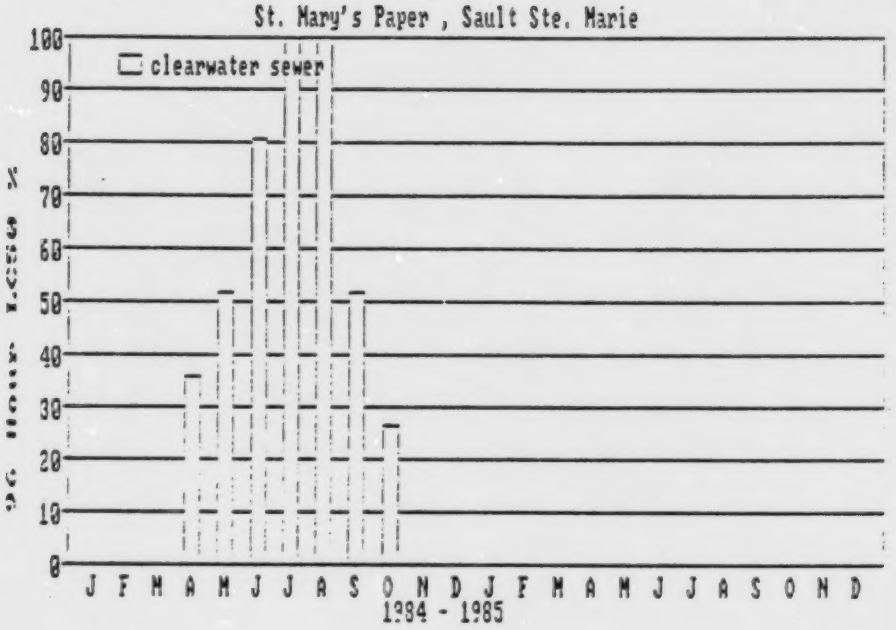


St. Mary's Paper , Sault Ste. Marie

SITE	TYPE	DATE	LC50	REMARKS
clear water sewer	grab	840704	100	
clear water sewer	grab	840719	100	non-lethal
clear water sewer	grab	840926	51.8	low DO 2.8 ppm
clear water sewer	grab	841022	26.4	
tailrace,100m.downstream	grab	840719	100	non-lethal
final effluent	grab	851110	29.1	

Abitibi Price , Sault Ste. Marie

SITE	TYPE	DATE	LC50	REMARKS
clearwater sewer	grab	840417	36	
clearwater sewer	grab	840509	51.9	
clearwater sewer	grab	840606	80.6	
final effluent	grab	830407	59.5	
final effluent	grab	830408	78	
final effluent	grab	830518	100	
main sewer	grab	760913	18	unaerated
main sewer	grab	760913	24	range 18-32%
main sewer	grab	770711	26	unaerated
main sewer	grab	810309	14	
St. Mary's River	grab	830518	100	

Strathcona Paper, Camden East Twp.

Strathcona Paper, Camden East Twp.

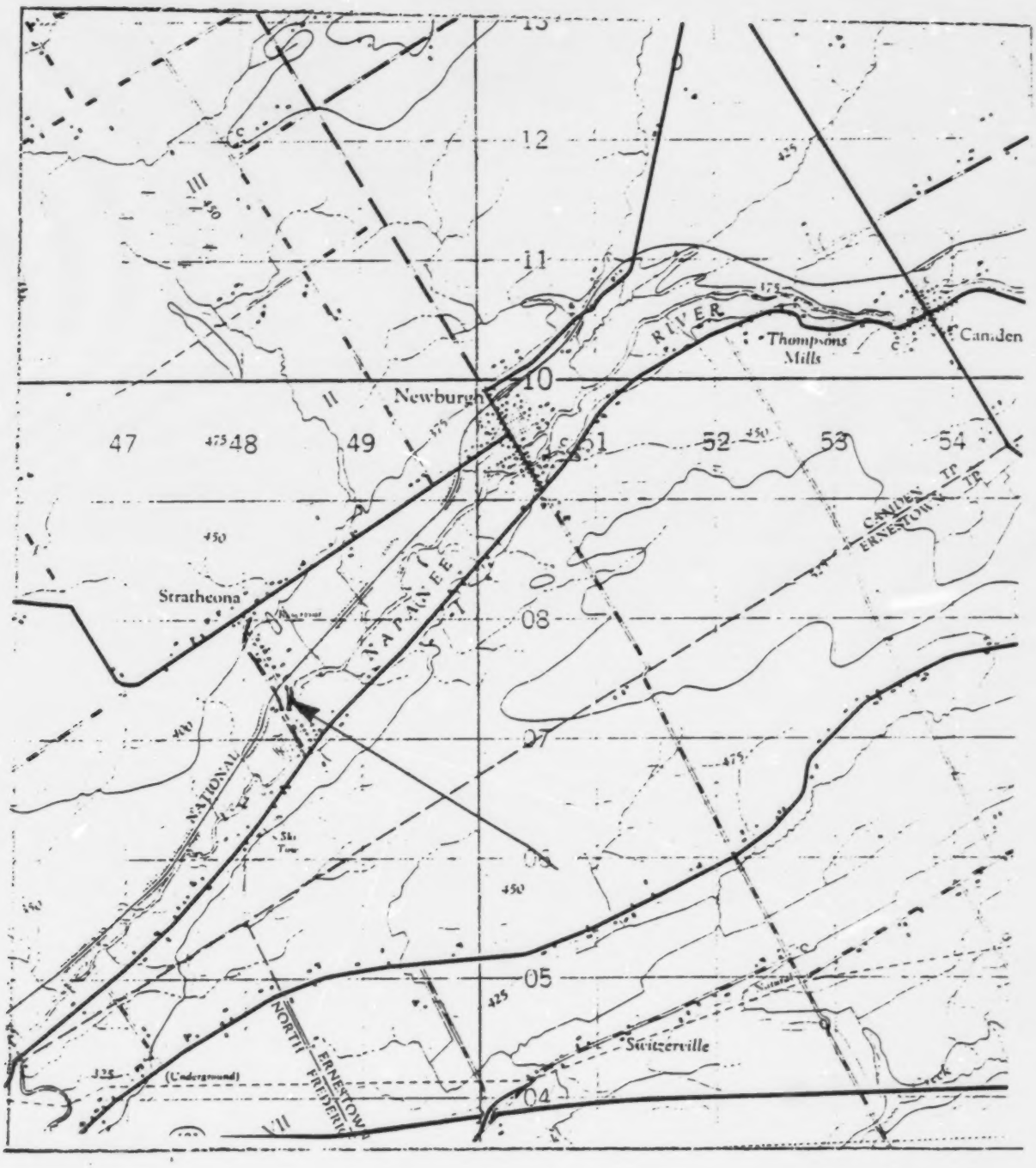
Receiving watercourse: Napanee River (via Bay of Quinte to Lake Ontario)

flow: cu m/day BOD: 305 Kg/day
SS: 132 Kg/day

One trout bioassay, performed in 1986, indicated the effluent to have been non-acutely lethal to test fish. Flow in the Napanee River varies from approx. 1 m^3/sec. to 40 m^3/sec.: flooding in the spring of 1983; very low flow in the summer of 1983. Boaters use the river during the summer. The average plant discharge to the River is approx. 0.03 m^3/sec. Waste paper might contain PCB's. No PCB's were found in the effluent sampled June, 1983.

The mill was built in 1872 and used neighbouring forests as source of logs. Since the area's forest resources have been completely depleted, the mill now relies on wastepaper as furnish. Paperboard is made from waste paper. Much of the ink is removed by pulp cleaners/screens prior to the cylinder paper maker. Eight cylinders at the wet end form paper sheets consisting of eight layers of fibre. The product consists of box board in grades of folding and non-folding categories which are produced in thickness ranging from 450 micrometers to 1150 micrometers to a maximum width of 2900 millimeters. Cation starch is added in two stages. Latex polymer is also used to dress the outside layer. The finished product is used in display boards, dry cereal boxes, clothing boxes, book match splints, coloured gift boxes, shoe boxes, office files, greeting cards, carry out food trays, and etc.

Mill installed settling and aeration lagoons. A river study in 1975 established the assimilation capacity with reference to BOD_5 loading objective from the plant. A Requirement and Direction was issued in 1976. The 1976 Requirement and Direction set a limit of 204 kilograms per day of BOD_5 between May 15 and October 15. The remainder of the year, BOD_5 is geared to flow in the river. BOD_5 loadings to the Napanee River are not dictated by a table of River Flows vs. Max. BOD_5 Loadings as set out on C of A #4-021-80-006 dated September 4, 1980 (BOD Loadings range between 204 and 613 kg/day for river flows between 1.2 and 3.45 m^3/sec.). In June 1983, the mill installed mechanical aerators to reduce odours and BOD_5 in the effluent. Solids from the lagoons are being investigated for reuse. Increased water recycling is being studied. Potential odour problems from the lagoons are of concern to the MOE. Long term objective is an additional clarifier or saveall to reduce solids to lagoons. The first saveall (1600 holes per square inch) wire mesh was installed in 1948. Seven sedimentation and aeration lagoons were installed between 1972-75. These lagoons are operated in series. A Krofta clarifier was installed in 1980. This is used to support water recycling within the plant. In 1983 10 aerators, total horsepower of 90 (2-25 HP, 8-5HP), were installed to reduce odours and BOD.


Newburgh
Thompsons Mills
Camden
RIVER
Stratheona
NAPANEE
NATIONAL
CANDEN ERNESTOWN
NORTH ERNESTOWN
Switzerville
(Underground)
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48
49
51
52
53
54
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12
08
07
06
05
04

Strathcona Paper Co. Ltd , Strathcona

Site	Type	Date	LC50	Remarks
lagoon # 7	grab	760607	22	unaerated
lagoon # 7	grab	760913	24	unaerated
lagoon # 7	grab	770706	100	non-lethal
lagoon # 7	grab	800526	10	
lagoon # 7	grab	805026	20	
lagoon # 9	grab	760607	45	unaerated
spray field runoff	grab	760712	90	unaerated
spray field runoff	grab	770530	100	non-lethal
spray field runoff	grab	770606	100	non-lethal

Trent Valley Paperboard Mills Div. Glen Miller, Ontario

Trent Valley Paperboard Mills Div.Glen Miller, Ontario

Receiving watercourse: Trent River via Bay of Quinte to Lake Ontario.

flow:	2250	cu m/day	BOD:	1830	Kg/day
DS:	2250	Kg/day	SS:	828	Kg/day

One trout bioassay, performed in 1984, indicated that it would take, statistically, 72%, effluent to kill 50% of the fish by the end of four days exposure.

The East Mill had originally used straw and rags to make paperboard; to-day the furnish is wastepaper. In 1976, a new West Mill was built which incorporated modern recycle and screening technology. The East Mill is now in full time operation. New mill management took over in 1980 due to a severe financial crisis. Selective waste paper is used to make boxboard and paperboard. The mill separates impurities like plastics and paper additives mechanically into lights, pulp and heavies. Lights and heavies are sent to landfill. The latest paper-machine can make a six layer paperboard.

TSS are reduced by in-plant control that is screening and recycle. Whitewaters must be segregated because different paperboards are made. A saveall clarifier has been installed at the East Mill. Two Krofta clarifiers were added in 1982.

Mount Zion
Glen Miller
Johnstown
Trenton
TRENTON
CFB TRENTON
NATIONAL
CANADIAN PACIFIC
BAY OF QUINTE
HASTINGS COUNTY
PRINCE EDWARD CO
SIDNEY TP
Onderdonk Point
Mordonald Porter Parkway
Trent Canal
401
33
87
88
89
BM 312
BM 305
BM 341
Golf Course
Trailer Park
Swing Bridge
Auto Wrecker
Gravel Pit
Dump
Orchard
Orchards
Poultry Farm
Trans Sta
Sewage Plant
Ski Lift
Res
Cem
Hosp

Trent Valley Paperboard Mills,Glen Miller

Site	Type	Date	LC50	Remarks
east side effluent	grab	820127	0	non-lethal
final effluent	grab	760913	85	unaerated
final effluent	grab	761406	50	
final effluent	grab	770606	100	>100%
final effluent	grab	800526	72	
final effluent	grab	840303	72	
final west side	grab	800526	100	>100 %
final west side	grab	820127	100	>100 %

Appendix A - Summary Plot.

Appendix B - Toxicity Test Protocol.

PROTOCOL TO DETERMINE THE ACUTE LETHALITY

OF LIQUID EFFLUENTS TO FISH

by

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Quality Protection Section
Water Resources Branch
Ministry of the Environment
Resources Road, Rexdale, Ontario
M9W 5L1

July 1983

INTRODUCTION

The following fish toxicity test protocol has been developed to support the Ministry's overall goal to ensure that surface waters in Ontario are of a quality which is satisfactory for aquatic life. The test is designed to identify industrial discharges acutely lethal to aquatic organisms as referred to in Policy 3 of the Ministry's publication "Water Management Goals, Policies, Objectives and Implementation Procedures". This toxicity test may also be used to assess whether materials or contaminants discharged into receiving waters impair the quality of that water or cause injury to animal life in assessing possible violations of the Ontario Water Resources Act, Section 16(1) and the Environmental Protection Act, Section 14(1a, b).

Biological tests are essential to determine whether the quality of water is satisfactory for aquatic life. The following biological test is capable of assessing the combined effects of toxicants in an effluent. This identifies whether an acutely lethal condition exists even when toxic levels of individual components have not been exceeded.

The following test is based on many years of toxicity test assessment and practice within the Ministry. The rainbow trout (Salmo gairdneri) has been selected as the test species in this protocol for many practical and scientific reasons. This species has been extensively studied in many laboratories. Its culture, physiology, pathology, disease association and sensitivity to industrial pollutants is well documented.

Any compound, mixture of compounds or liquid waste sample tested according to the following protocol that produces a 96-hour LC50* of less than 100% concentration shall be considered acutely lethal to fish.

*96-hour LC50 (lethal concentration to 50%) concentration of effluent sample that is lethal to 50% of the fish exposed to that concentration over a 96-hour period.

PROCEDURE

a) Effluent Sampling and Handling Requirements

The sample must be considered as representative of the effluent by the Ontario Ministry of the Environment. The effluent sample must be collected, transported and stored in sealed clean non-toxic polyethylene containers from which air has been excluded by complete filling. The sample should not be aerated during storage and the test should commence as soon as possible but must be within 5 days (120 hours) of collection.

b) Laboratory Qualification

Recognition of the test result by the Ministry of the Environment is dependent upon the test being conducted in a laboratory licenced under the Animals for Research Act, administered by the Ontario Ministry of Agriculture and Food, Veterinary Services Branch.

c) Test Requirements

(i) Rainbow trout (Salmo gairdneri) are to be used as the test species.

(ii) Only healthy stocks of acclimated fish as described in section (d) are to be used.

(iii) Individual fish are to weigh between 0.5 and 5.0 grams and the length of the largest fish should not be more than two times the smallest in the same test.

(iv) The water used to dilute the effluent sample must meet all water quality objectives as outlined in Table 1 of the Ministry's publication "Water Management Goals, Policies, Objectives and Implementation Procedures". In addition, dilution water must contain less than a 30 µg/L concentration of total residual chlorine and be capable of maintaining healthy fish stocks for at least ten consecutive days in accordance with item (d).

(v) A concentration range of the bioassay sample must be tested in order to calculate a 96-hour LC50 value. An appropriate logarithmic dilution series should be used which will permit the calculation of 95% confidence limits for the LC50 value using statistically valid methods. A control solution consisting of a 100% concentration of dilution water must also be included in the test.

(vi) For every one gram of fish, there must be at least 0.5 litres of test solution for every 24 hours the fish are exposed.

(vii) The test fish should not be fed within the 24-hour period prior to nor during the test.

(viii) An equal number of fish should be introduced into each test solution at the start of the test. There should be ten fish exposed to each test solution with a minimum of six fish per concentration required for a test to be considered valid.

(ix) Test containers must be non-toxic, inert and non-abrasive.

(xi) A test temperature of 15 +/- 1°C should be maintained and must not deviate from the range of 13-17°C.

(xii) The dissolved oxygen concentration of the test solutions must be measured prior to starting the bioassay. If the dissolved oxygen levels of a test solution is less than 7.0 mg/L, it should be pre-aerated for a minimum period, not to exceed two hours; in order to raise the dissolved oxygen levels to 7.0 mg/L. The rate of aeration must be within the range of 5.0-7.5 cc/min/L.

(xiii) The fish should be introduced to each test solution immediately after the dissolved oxygen concentration is measured to be 7.0 mg/L or more, or immediately after the maximum pre-aeration time limit has expired. The time of introduction of fish should be recorded for each test solution.

(xiv) All fish in a test must be taken from the same fish stock. A random selection of fish from that stock must be distributed among the test solutions.

(xv) An aeration rate of 5.0 to 7.5 cc/min/L should be applied to the test and control solutions throughout the test period.

(xvi) The light regime during the test must be identical to conditions during the holding period (see item d,iv).

(xvii) Observations for fish mortality should be undertaken and recorded as often as possible, with mandatory observations at test times of 1/2, 1, 2, 4, 24 hours and at increments of 24 hours thereafter, including a 96-hour final observation. Dead fish should be removed immediately upon observation. A fish is considered dead when, upon mild mechanical prodding, there is no visible respiratory or other movement. A record should be kept of fish that lose equilibrium but are not dead within the 96-hour time period. If the fish in a test solution appear under stress and recover during the test, an observation to that effect should be recorded.

(xviii) The test is rendered invalid if more than 10% of the fish in the control test solution die within 96 hours.

(xix) All control fish must be sacrificed, weighed and measured (total length) at the termination of the test. All remaining test fish must be sacrificed and disposed of according to d(i).

d) Test Fish

(i) Procurement of Fish Stocks

Stocks of healthy rainbow trout for use in these tests must be certified as free of disease or disease agents as described in Schedule B of the Fish Health Protection Regulations under the Fisheries Act of Canada. This may be accomplished by the purchase of cultured fish from one of the numerous licenced and certified disease free hatcheries operating in Ontario. Otherwise individual stocks of fish must be bacteriologically and virologically diagnosed to determine them as disease free. The following pathogens must not be found in the test fish.

a) Viral Hemorrhagic Septicemia (Egtved) (Egtved virus, VHSV).
b) Infectious Hematopoietic Necrosis (IHNV)
c) Infectious Pancreatic Necrosis (IPNV)
d) Whirling Disease (Myxosoma cerebralis)
e) Ceratomyxosis (Ceratomyxa shasta)
f) Furunculosis (Aeromonas salmonicida)
g) Bacterial Kidney Disease (KD bacterium)
h) Enteric Redmouth Disease (RM bacterium)

At no time must bioassay fish stocks be exposed to prophylaxis or disease treatment (e.g. formalin, malachite green, antibiotics). All diseased fish must be destroyed and sanitarily disposed of, so as not to spread infectious pathogens into receiving waters. Incineration, autoclaving and other sterilization techniques may be used.

(ii) Holding and Acclimation of Fish

Fish should be acclimated to the laboratory conditions for a period of at least 10 days prior to testing and during this time they must be actively feeding and appear as "healthy" (e.g. no abnormal behaviour, no lesions or excessive mucus). Cumulative mortalities during the acclimation and holding period must be less than 1% for the 4 days prior to testing.

Monitoring and assessment of parameters such as pH, chlorine, ammonia, temperature, dissolved oxygen in the holding waters should be performed as frequently as necessary to ensure good quality. Acceptable concentration levels for the maintenance of healthy fish stocks are discussed in the explanatory note in the Biological Test Manual, Ontario Ministry of the Environment (in prep.).

(iii) Holding Facilities

The acclimation tanks and accessories must be made of non-toxic, non-abrasive materials and should be located away from any physical disturbances, preferably in a location separate from the test area. Tanks should be cleaned regularly by scrubbing of the surfaces and siphoning of the settled material.

During the acclimation and holding of fish a constant flow of water through the holding tanks is necessary. Rates of water exchange in holding tanks must be a minimum of 1.4 L/g of fish per day.

(iv) Photoperiod

Natural lighting would be preferable, however, if artificial lighting is used the photoperiod should be representative of the geographical location. To account for seasonal variation, the photoperiod should range from a minimum of 9 hours to a maximum of 15 hours of continuous light and the corresponding continuous hours of darkness. Light intensity at the water surface should be 20 to 30 lux and be of natural light spectrum quality.

(v) Temperature

Since the temperature of the holding water used during the transfer of fish from the hatchery to the laboratory may be outside of the testing limits (13-17 ^{o}C), it may be necessary to gradually change the holding water temperature. The temperature may be changed at a rate not to exceed $1^{o}C$ per hour and for

a total of 5°C per day until the testing temperature is achieved. Fish should then be held for 10 days at this temperature but must be held for a minimum of 5 days to complete the acclimation procedure. If during this period, the temperature fluctuates outside the range of 13°C to 17°C, the acclimation is invalidated and must be repeated.

TOXICITY TEST REPORT REQUIREMENTS

The following information must be in the toxicity test report.

(i) Sample

-name
-method of collection
-location
-collector
-date of collection
-collection time
-chemistry profile (pH, conductivity
-other chemical parameters may be required depending on the industry sampled.

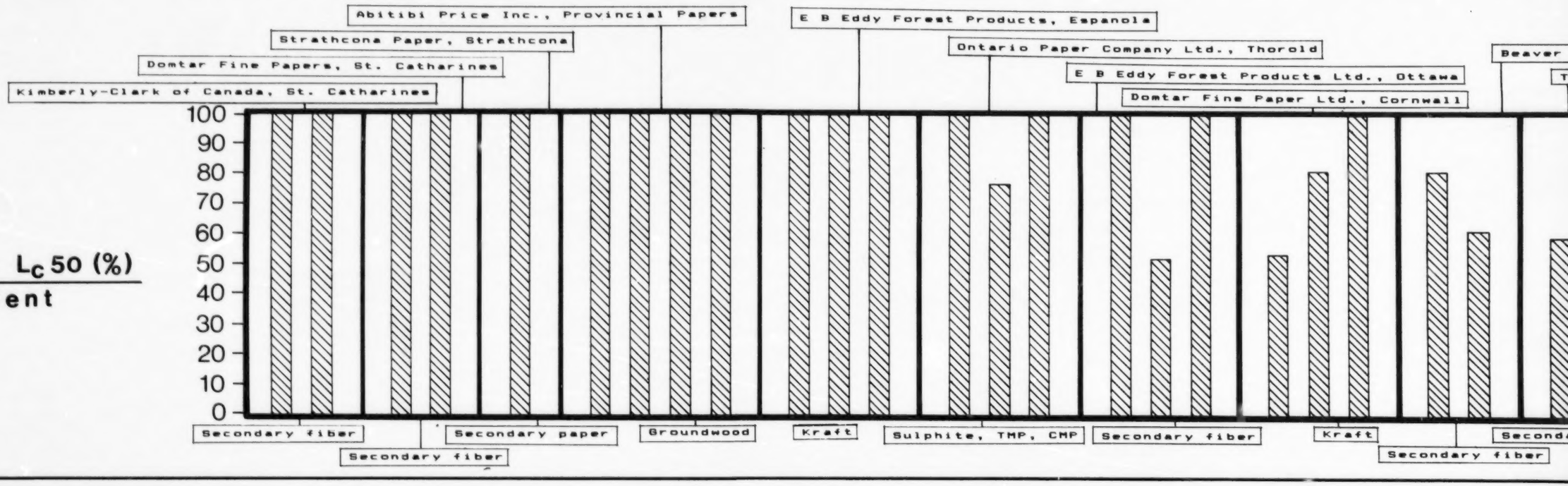
(ii) Test Conditions

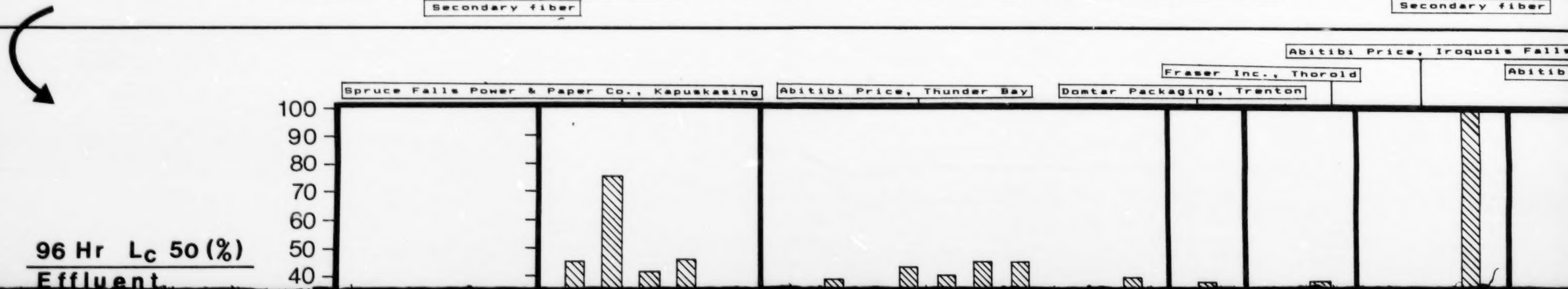
-laboratory identification
-date of test
-test (static, semi static, constant flow)
-temperature range
-test volume
-fish source
-fish acclimation schedule
-light regime
-individual fish lengths (control)
-individual fish weights (control)
-holding and dilution water quality (pH, alkalinity, hardness, Ca, Mg, K, Na, Cl, conductivity, metals (Cu, Zn, Pb, Ni, Cd), NH_3, and total residual chlorine.

(iii) -LC50 and 95% confidence interval and method of calculation
-raw mortality dates (times to death)
-mortality curve
-loading rate of the bioassay solutions (liters of solution/cumulative fish weight/days of a test)
-pH, dissolved oxygen and conductivity of test solutions at start of test and in a test solution at the time of 50% mortality.

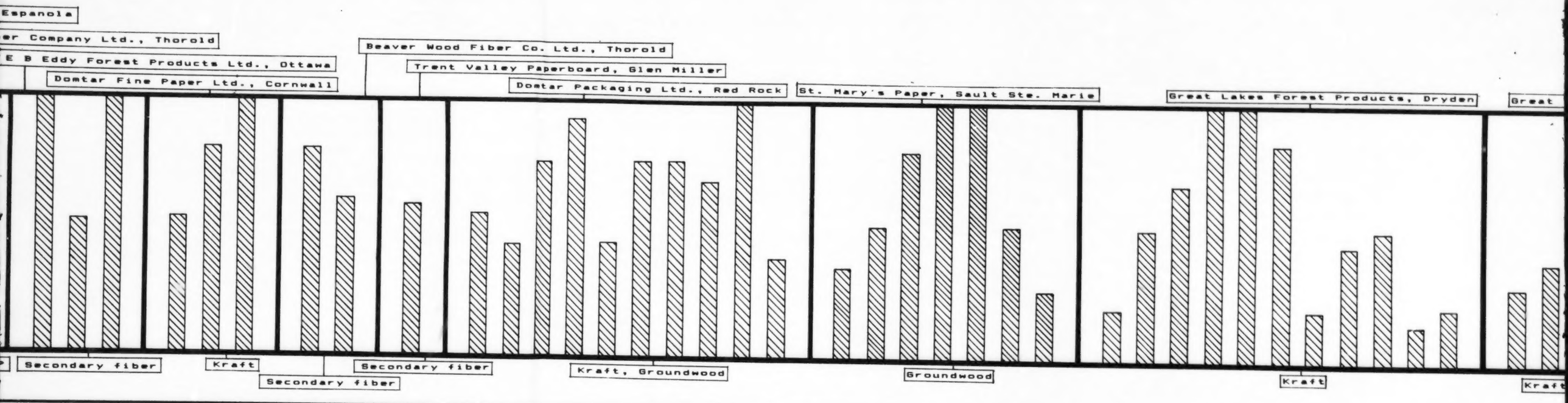
(iv) -indications of stress.

Acute Lethality of Ontá





Acute Lethality of Ontario Pulp & Paper Effluents to Rainbow Trout



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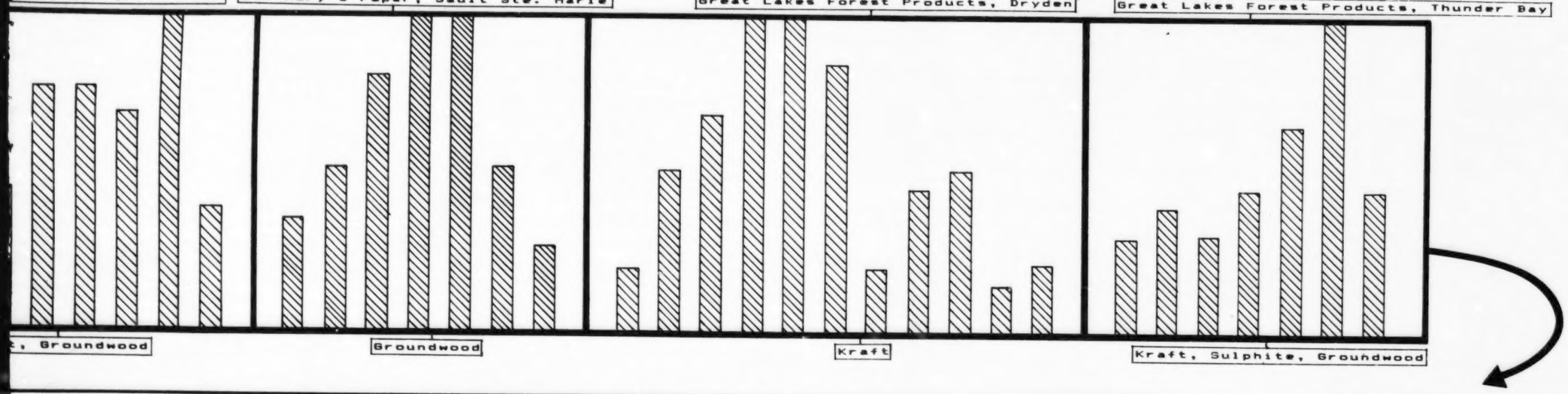
, Glen Miller

ging Ltd., Red Rock

St. Mary's Paper, Sault Ste. Marie

Great Lakes Forest Products, Dryden

Great Lakes Forest Products, Thunder Bay



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Canada, Terrace Bay

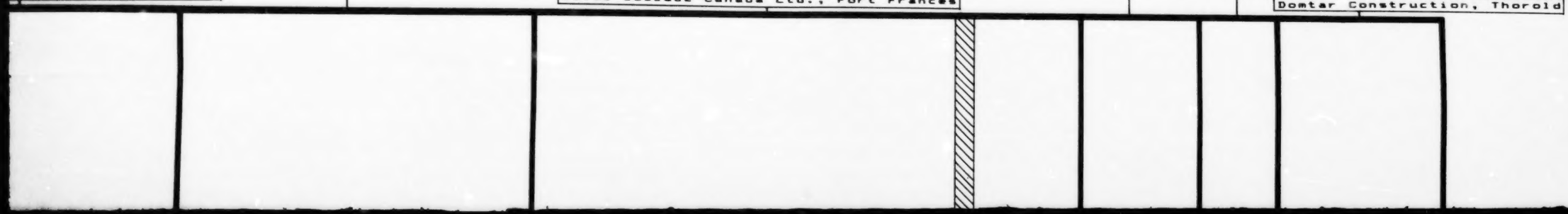
James River-Marathon, Marathon

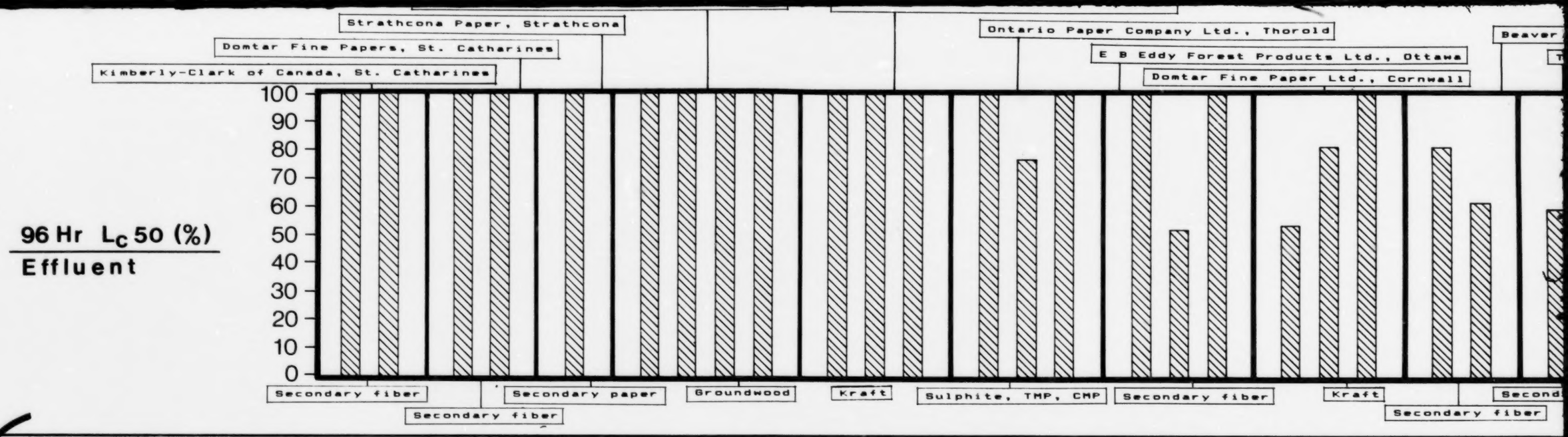
Boise Cascade Canada Ltd., Fort Frances

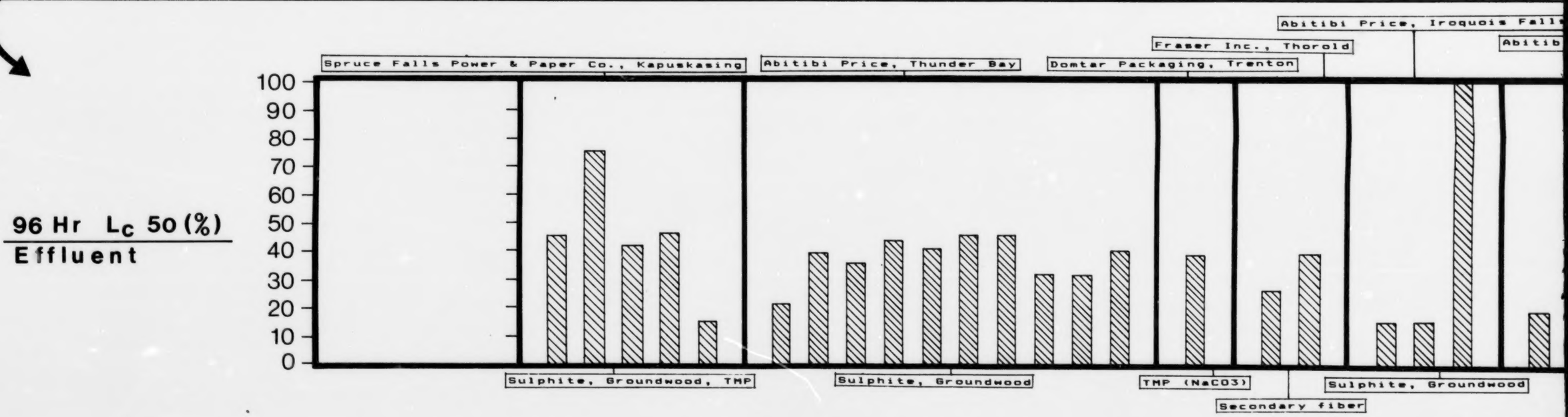
Boise Cascade Canada Ltd., Kenora

MacMillan Bloedel, Sturgeon Falls

Domtar Construction, Thorold




96 Hr L_C 50 (%)
Effluent
100
90
80
70
60
50
40
30
20
10
0
Kimberly-Clark of Canada, St. Catharines
Domtar Fine Papers, St. Catharines
Strathcona Paper, Strathcona
Ontario Paper Company Ltd., Thorold
E B Eddy Forest Products Ltd., Ottawa
Domtar Fine Paper Ltd., Cornwall
Beaver
Secondary fiber
Secondary fiber
Secondary paper
Groundwood
Kraft
Sulphite, TMP, CMP
Secondary fiber
Kraft
Secondary fiber
Seconda


96 Hr L_C 50 (%)
Effluent
100
90
80
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50
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0
Spruce Falls Power & Paper Co., Kapuskasing
Abitibi Price, Thunder Bay
Domtar Packaging, Trenton
Fraser Inc., Thorold
Abitibi Price, Iroquois Falls
Abitib
Sulphite, Groundwood, TMP
Sulphite, Groundwood
TMP (NaCO3)
Secondary fiber
Sulphite, Groundwood

Paper Company Ltd., Thorold

E B Eddy Forest Products Ltd., Ottawa

Domtar Fine Paper Ltd., Cornwall

Beaver Wood Fiber Co. Ltd., Thorold

Trent Valley Paperboard, Glen Miller

Domtar Packaging Ltd., Red Rock

St. Mary's Paper, Sault Ste. Marie

Great Lakes Forest Products, Dryden

Gr

CMP

Secondary fiber

Kraft

Secondary fiber

Secondary fiber

Kraft, Groundwood

Groundwood

Kraft

Abitibi Price, Iroquois Falls

Fraser Inc., Thorold

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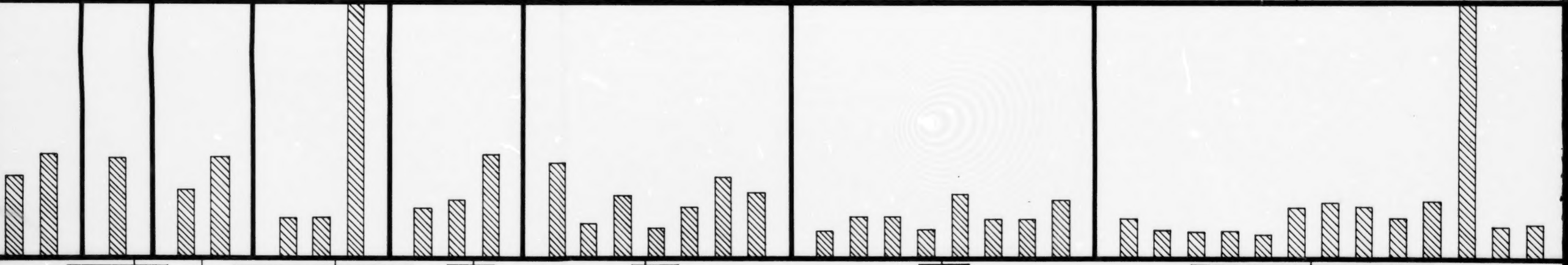
Abitibi Price, Smooth Rock Falls

Kimberly-Clark of Canada, Terrace Bay

James River-Marathon, Marathon

Boise Cascade Canada Ltd., Fort Frances



TMP (NaCO3)

Secondary fiber

Sulphite, Groundwood

Kraft

Kraft

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Kraft, Sulphite, Groundwood

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Glen Miller

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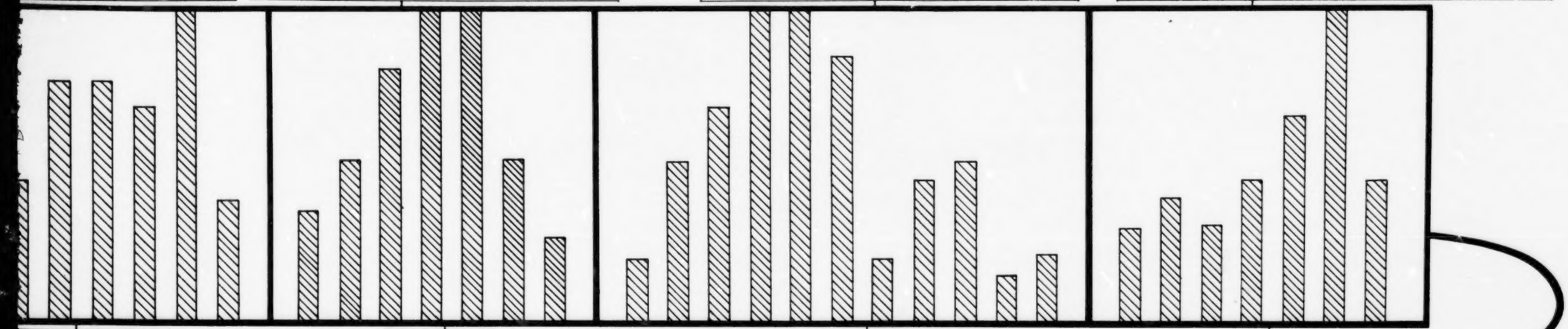
St. Mary's Paper, Sault Ste. Marie

Great Lakes Forest Products, Dryden

Great Lakes Forest Products, Thunder Bay



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Groundwood

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James River-Marathon, Marathon

Boise Cascade Canada Ltd., Fort Frances

Boise Cascade Canada Ltd., Kenora

MacMillan Bloedel, Sturgeon Falls

Domtar Construction, Thorold

Kraft

Kraft

Kraft, Sulphite, Groundwood

Sulphite, Groundwood

Sulphite

Secondary fiber